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DRAFT WORK PLAN
KEYSTONE SANITATION LANDFILL SITE

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
FOR OPERABLE UNIT 2

EPA WORK ASSIGNMENT NO. 37-52-3SL9
PROJECT NO. 0986

ARCS III PROGRAM

EPA CONTRACT NO. 68-W8-0037

JULY 1994

Halliburton NUS
CORPORATION

AR322695

EPA 210546

DRAFT

R-51-5-4-20

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FOR THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

JULY 1994

SUBMITTED BY	REVIEWED BY	APPROVED BY
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SECTION 1.0

1.0 INTRODUCTION

In response to Work Assignment No. 37-52-3SL9 under EPA Contract Number 68-W8-0037, Halliburton NUS Corporation (HNUS) is submitting this work plan for performance of a remedial investigation/feasibility study (RI/FS) at the Keystone Sanitation Site. This activity, to be conducted for Operable Unit 2 (OU-2) of the Keystone Sanitation Site, is the second RI/FS to be conducted at the site. The OU-2 RI/FS will be designed to investigate contamination in the area surrounding the Keystone Sanitation Landfill. This work plan was developed based on a review of historical data, site visits, and the results of discussions held among HNUS, EPA, the Pennsylvania Department of Environmental Resources (PADER), the Maryland Department of the Environment (MDE), and the Keystone Sanitation Task Force, which consists of representatives of the communities surrounding the landfill.

1.1 PURPOSE

This work plan was developed to guide the RI/FS for OU-2 for the Keystone Sanitation Landfill. The initial RI/FS (OU-1; involved on-site and off-site evaluation) at the Keystone Sanitation Site was completed in July 1990, and a Record of Decision (ROD) was signed in September 1990. A remedial alternative was selected for the landfill; however, as part of the ROD, a decision was made to conduct an additional study to better assess the off-site environmental and health impacts of the landfill operations.

The goal of the RI/FS for OU-2 at the Keystone Sanitation Landfill is to characterize the nature and extent of off-site contamination associated with site-related landfilling activities, to provide a comprehensive assessment of the actual and potential human health and environmental risks associated with the site, and to develop and screen remedial alternatives. A previously conducted RI/FS at the Keystone Sanitation Site investigated on-site and off-site contamination and hydrogeologic conditions. However, the purpose of the OU-2 RI/FS is to provide additional data to supplement previous studies and to fill existing data gaps. The media to be investigated include groundwater, surface water and sediment, soil, and air (methane gas). A hydrogeologic investigation will be completed to define hydraulic characteristics of the groundwater system in off-site areas. Multiple rounds of sampling are proposed for the OU-2 RI/FS and should provide the necessary data to fill existing data gaps. The scope of work presented in this work plan is also designed to provide the data to evaluate remedial alternatives during the feasibility study.

This work plan presents the technical scope of work and the schedule for performing OU-2 RI/FS activities. The estimated costs for this work are provided under separate cover.

1.2 ORGANIZATION

This work plan is organized into five sections. Section 1.0 is this introduction. Section 2.0 presents an overview of the site description, history, and environmental setting drawn from historical files, site visits, and available reference information. Section 3.0 draws upon available site information to discuss potential risk, engineering, and regulatory issues. This section also develops a list of data needs and presents the field activities that are planned to meet the RI objectives. Section 4.0 presents the approach to the RI/FS that will be taken to implement the scope of work developed in Section 3.0. Section 5.0 describes the project management approach to be taken, including project organization, responsibilities, and schedule.

SECTION 2.0

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2.0 SITE BACKGROUND INFORMATION

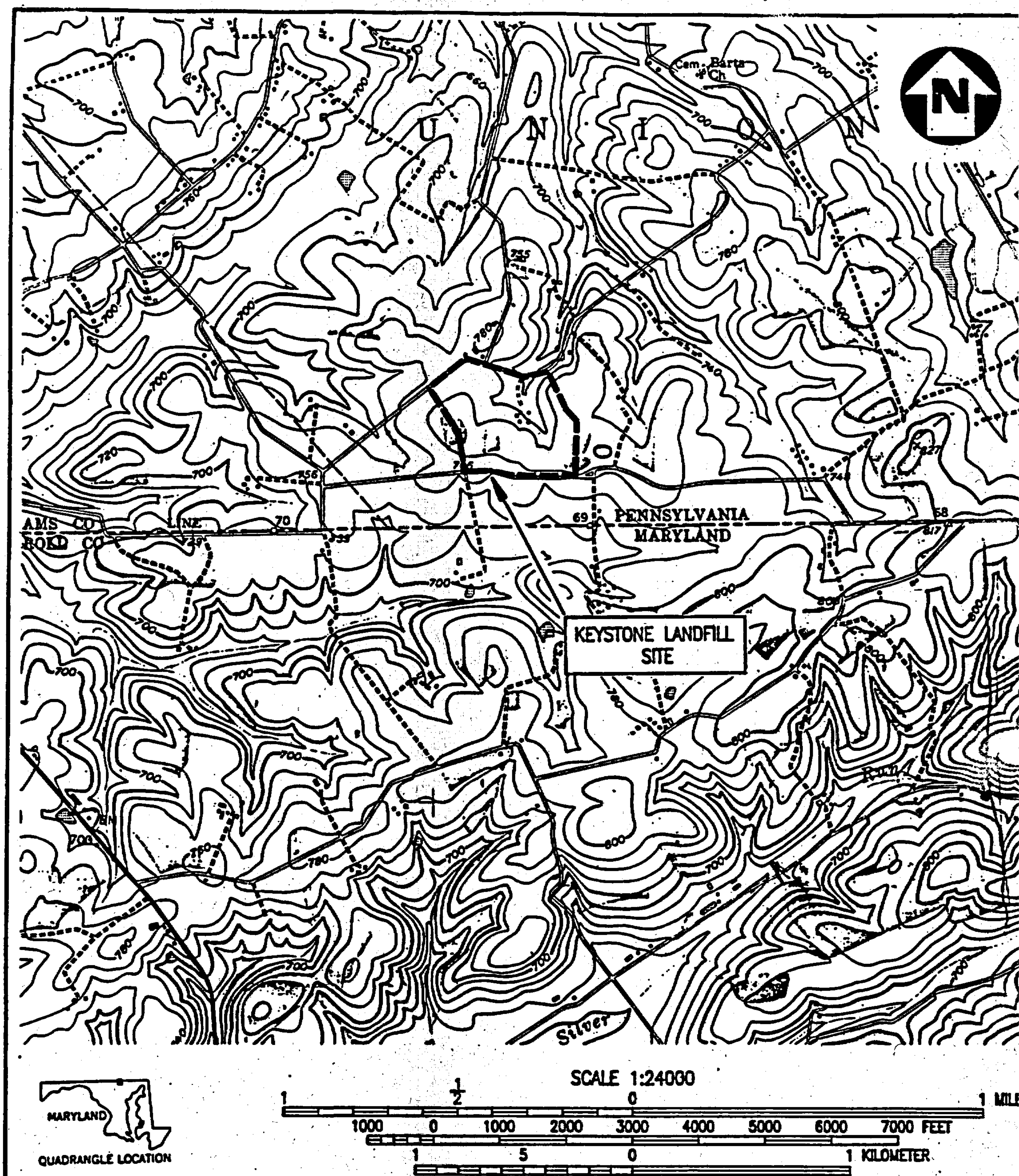
2.1 SITE LOCATION AND DESCRIPTION

The Keystone Sanitation Landfill Site is an inactive, privately owned facility (Keystone Sanitation Company) that was permitted by PADER to receive household and municipal wastes and certain types of industrial and construction debris. The landfill is located on a 40-acre tract of land in Union Township, Adams County, Pennsylvania, southwest of Hanover, Pennsylvania, approximately 800 feet north of the Pennsylvania-Maryland border (see Figure 2.1). The entire site has been fenced in accordance with the September 1990 ROD for OU-1. The site is bordered by Line Road to the south and Clouser Road to the north.

The landfill, which was operated from 1966 to April 1990, is situated on top of a ridge. The owner of the landfill resides in a home on the edge of the landfill property. There are approximately 36 residents within a one-mile radius of the Keystone Site and approximately 700 residents within a three-mile radius of the site. Littlestown, Pennsylvania, the closest town to the site, has a population of approximately 3,000 and is located three miles north of the site. Some residences are located near the landfill, but the predominant land use is agricultural, not residential. Residents in the vicinity of the site utilize domestic wells to obtain their water supply.

The topography of the area consists of gently rolling hills and valleys formed by the northeast-trending elongated valleys and ridges. Most surface water flows northward to an unnamed perennial tributary of Conewago Creek located 100 feet north of the site. A smaller quantity of runoff flows southward into an unnamed tributary to Piney Creek. The unnamed tributary is located about 2,000 feet south of the site in the state of Maryland (see Figure 2.2).

The landfill was constructed without a liner or leachate treatment or collection system. Wastes were deposited to a depth of 30 feet. Fractured bedrock of the Marburg Schist underlies the site and is overlain by varying thicknesses of silty clay soil that was used for constructing the base of each cell and for daily, intermediate, and final cover. The landfill's maximum elevation is approximately 700 feet, with a vertical relief of approximately 100 feet within a 2,000-foot radius of the site. A perennial grass cap is growing over the site.



SOURCE: (7.5 MINUTE SERIES) U.S.G.S. LITTLESTOWN, MD.–PA., QUADRANGLE

FIGURE 2–1

SITE LOCATION MAP
KEYSTONE LANDFILL, LITTLESTOWN, PA.
(SCALE 1:24000)

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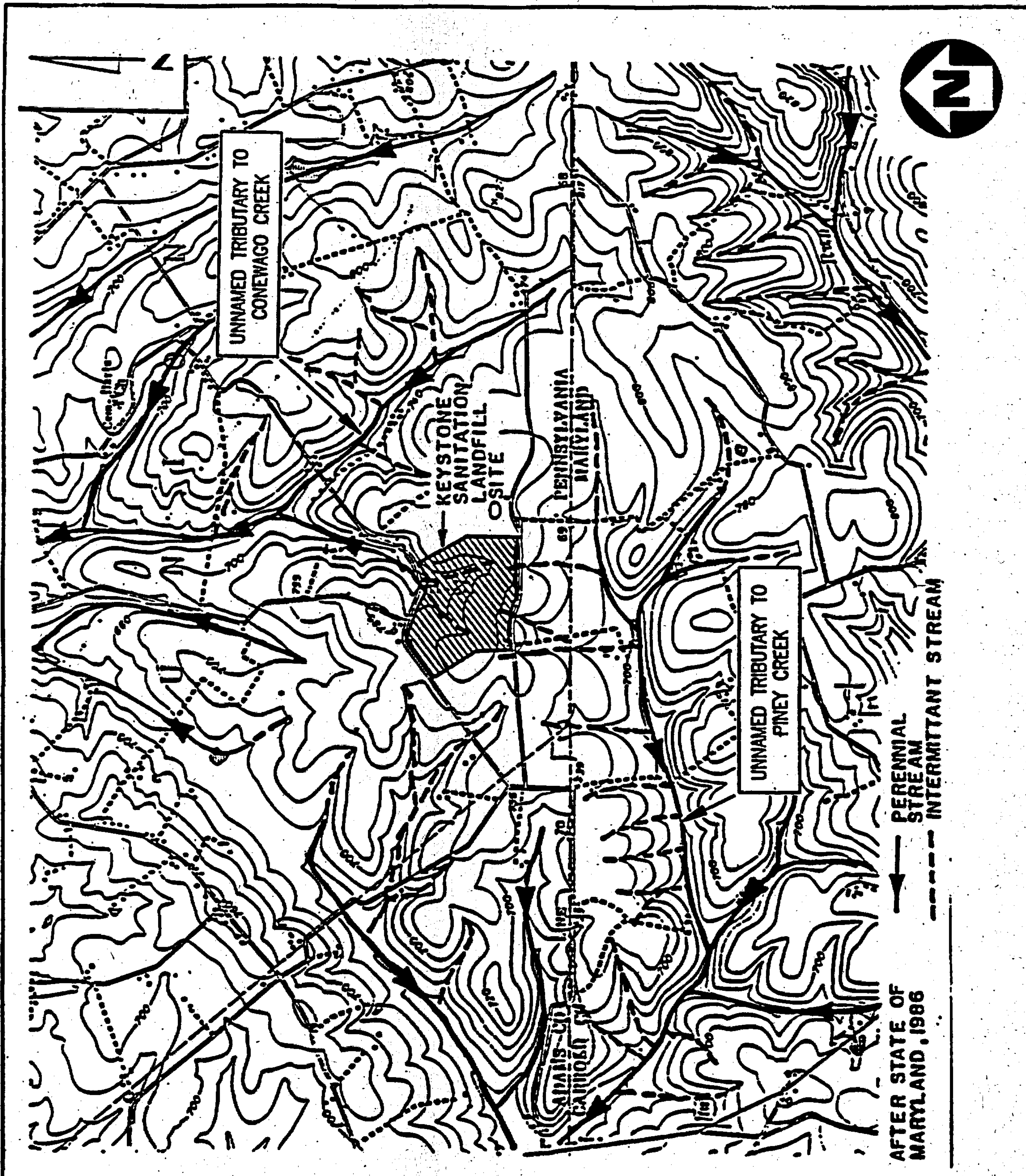

SOURCE: C.C.JOHNSON & MALHOTRA, P.C., DECEMBER 1987

FIGURE 2-2

STREAMS IN THE VICINITY OF OU2 STUDY AREA
KEYSTONE LANDFILL, LITTLESTOWN, PA.
(SCALE 1:24000)

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2.2 SITE HISTORY

From 1966 (pre-dating the establishment of PADER in 1970) until April 1990, the Keystone Site was used as a sanitary landfill. It is estimated that 300 to 376 tons per day of waste were disposed at the site. In 1974, five monitoring wells (K1, K2, K3, K4, and K5) were installed by Keystone at the landfill perimeter to monitor groundwater quality (see Figure 2.3).

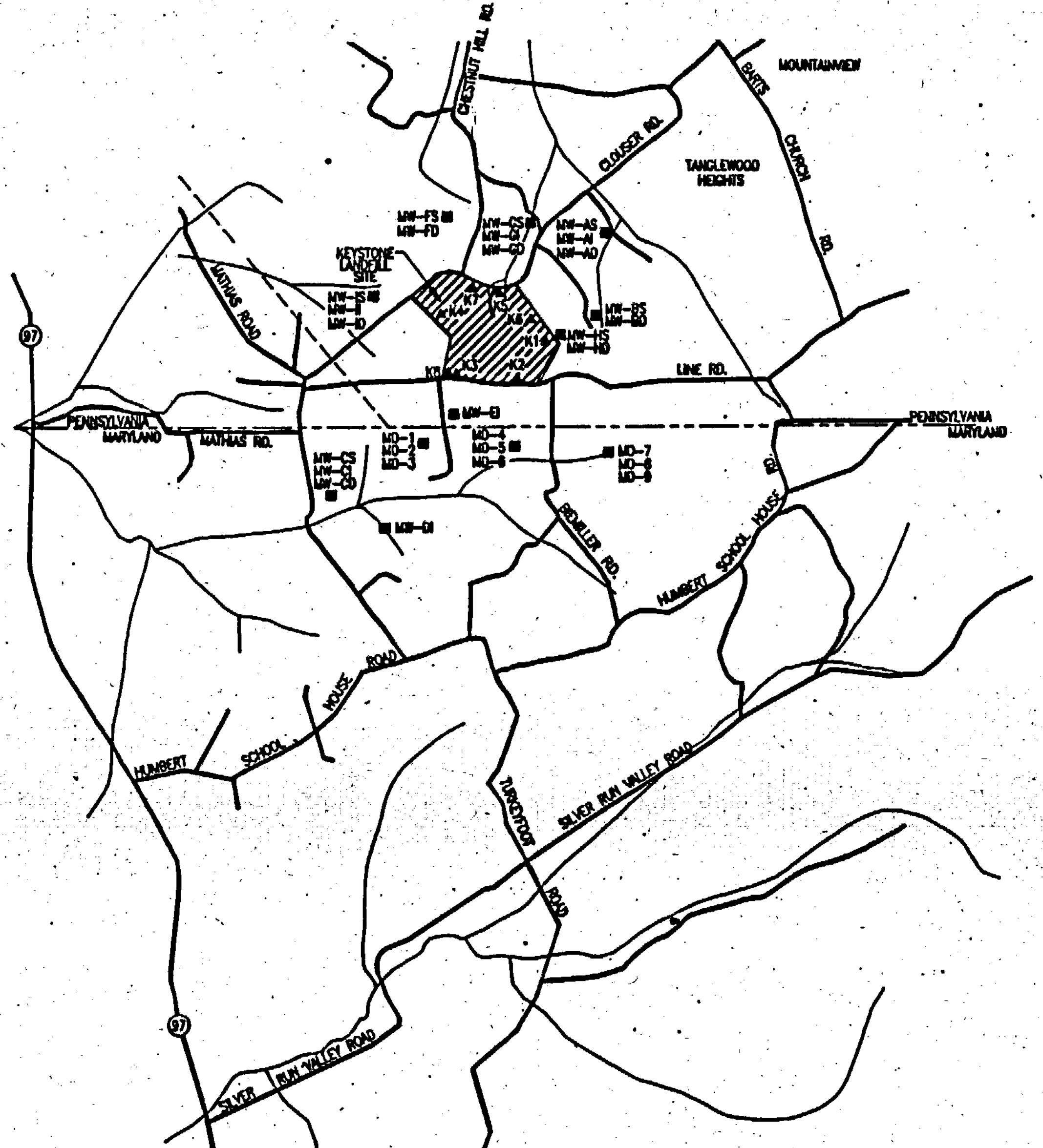
In 1982, all facilities permitted by PADER were required to monitor groundwater for volatile organic compounds (VOCs). A sample taken by PADER in November 1982 from Keystone monitoring well K1 revealed VOC contamination in the groundwater. Subsequent testing of the on-site residential well and the nearby Mundorff Spring revealed that they also contained VOCs.

In April 1984, the EPA Region III Field Investigation Team (FIT) performed a site investigation in response to citizen complaints of illegal dumping and groundwater contamination and to assess the site's eligibility for inclusion on the EPA National Priorities List (NPL), established pursuant to Section 105 of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. 9605. Sample results from the PADER and EPA FIT investigations confirmed that some residential wells contained low levels of VOC contamination.

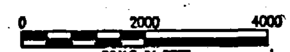
In August 1984, as a result of the VOC contamination, Keystone installed a spray irrigation system in the most contaminated area of the landfill to prevent the migration of contaminants off site and to remove VOCs from the groundwater. Water from Keystone monitoring well K1 was pumped to a series of sprayers located at the edge of the landfill, within the radius of influence of the well. This system is no longer active. In addition, a leachate collection system was installed on the southern side of the landfill along Line Road. The leachate collection system consisted of two approximately 10-foot lengths of six-inch perforated pipe located at the base of the landfill. The pipe ran parallel to Line Road and discharged into a storage tank. The storage tank was pumped periodically, and the contents were disposed off site.

In the spring of 1985, the state of Maryland installed a series of monitoring wells at the Maryland border to monitor potential contaminant migration into Maryland. Low levels of VOC contamination have been consistently detected in Maryland well no. 2 (MD2) (see Figure 2.3), located approximately 1,500 feet south-southwest of the landfill.

The Keystone Site was placed on the NPL in July 1987. In July 1987, the potentially responsible parties (PRPs) were asked to perform the RI and FS for the site. Negotiations failed to obtain cooperation from the PRPs to do the RI/FS, and EPA assigned the RI/FS tasks to an EPA contractor.



MONITORING WELL LOCATIONS
KEYSTONE LANDFILL



NOTE

ADDITIONAL MONITORING WELLS EXIST AND WILL BE INVENTORIED DURING OU-2 INVESTIGATION.

LEGEND

▲ K3 ON SITE MONITORING WELL

■ MD-7 MD-8 MD-9 OFF SITE MONITORING WELL

FIGURE 2-3

Halliburton NUS CORPORATION

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Also in July 1987, Keystone signed a Consent Adjudication (CA) with PADER. The intent of the CA was to provide data for the development of an on-site groundwater remediation plan and to design and implement the plan. Keystone was required by the CA to analyze and summarize previously collected water quality data, determine the effectiveness of the existing spray irrigation system, install three additional monitoring wells, abate groundwater contamination at the site perimeter, and prevent off-site groundwater contamination.

The RI/FS field activities began in the spring of 1989 and were completed in the winter of 1990. the objectives of the RI were to determine the nature and extent of hazardous substances, pollutants, or contaminants at the site; to determine the impact of these hazardous substances on human health and the environment; to determine the extent to which sources of contaminants could be adequately identified and characterized; to gather sufficient information to determine the necessity for remedial action; and to provide data in order to evaluate and estimate costs for remedial alternatives during the FS.

The purpose of the FS was to develop a range of cost-effective remedial alternatives that are protective of human health and the environment and that comply with applicable or relevant and appropriate requirements (ARARs).

The RI/FS was finalized on July 20, 1990 and released to the public, along with a Proposed Remedial Action Plan. A 60-day public comment period followed the release of these documents.

On September 30, 1990, the EPA Region III Administrator signed the ROD for OU-1, selecting groundwater extraction and treatment and the installation of an impermeable landfill cap as the remedy to address the risks to human health and the environment posed by groundwater contamination from the site.

The ROD also provided for further study (OU-2) to address off-site contamination. This work plan has been developed to direct the OU-2 investigation. Some of the components of the OU-2 RI (e.g., quarterly sampling of monitoring wells, residential wells, surface water and sediments in the first year) will satisfy some specific requirements of the OU-1 remedy.

In order to begin some of the media monitoring activities required in the OU-1 ROD before OU-2 work plan approval, EPA has utilized the Technical Assistance Team (TAT) contractor and has provided some funding for HNUS. The OU-2 field activities that have been begun are as follows:

- Two rounds of residential well sampling were completed in February and June (TAT contractor).

- A subcontract was awarded for the installation of dedicated pumps in 29 existir monitoring wells. The work is scheduled for July 1994 (HNUS).

- The first round of monitoring well/ spring sampling is scheduled for August 1994 (HNUS) A letter SAP and HASP have been submitted to EPA for this activity.

Funding has also been provided for HNUS to summarize the data from the first round of monitoring wel sampling for submittal to EPA. The additional rounds of media sampling will be conducted after the OU-2 RI/FS work plan is submitted.

2.3 GEOLOGY

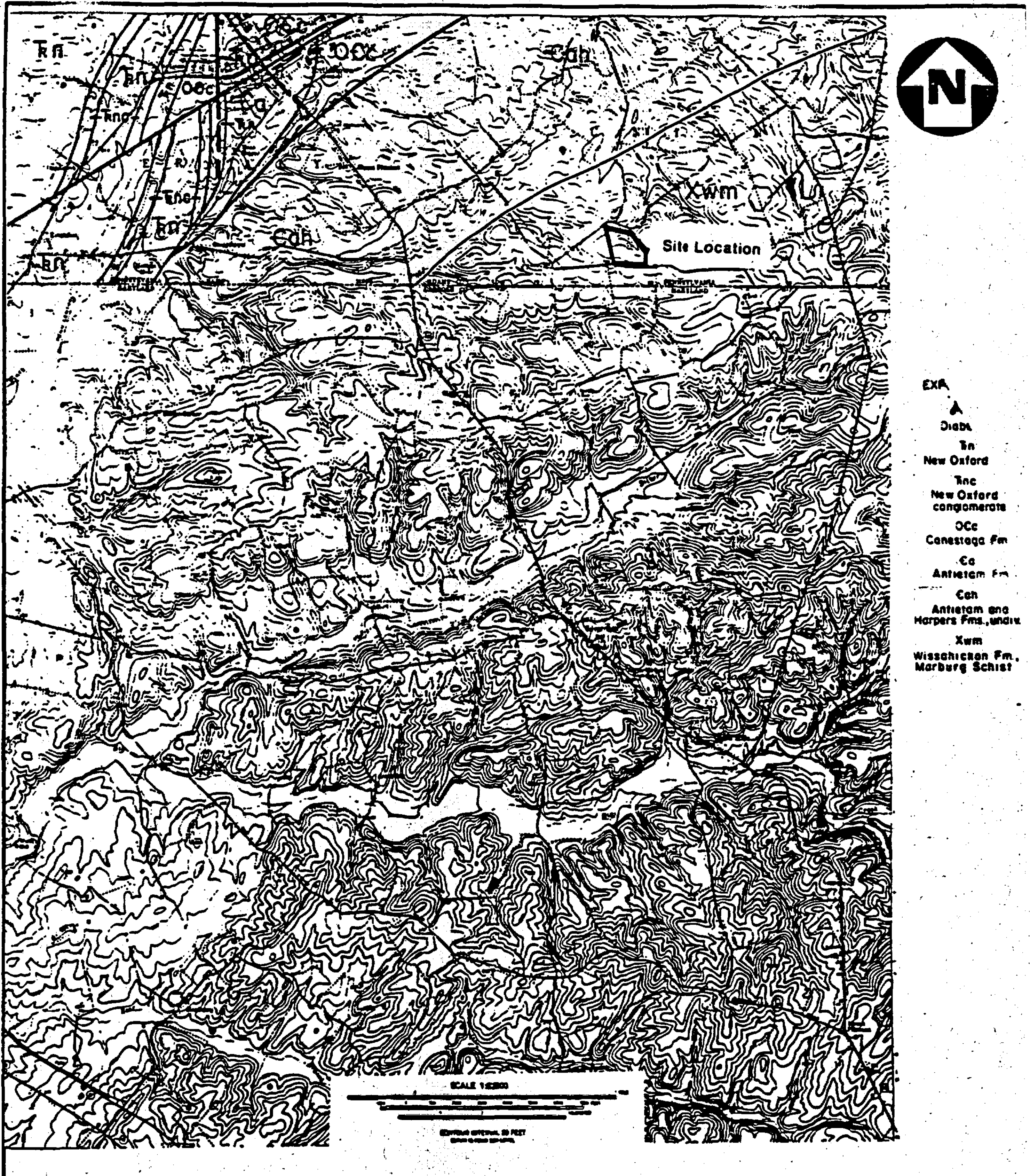
2.3.1 Regional Geology

The Keystone Sanitation Landfill is located in the Upland section of the western Piedmont Physiographic Province. This province is bordered on the east by the Coastal Plain Province and on the west by the Blue Ridge Province. The contacts with these neighboring provinces occur well outside the OU-2 area of investigation.

The western Piedmont Physiographic Province is underlain by predominantly phyllitic rocks of sedimentary origin. The region has undergone several episodes of intense structural deformation that has folded, fractured, and faulted the bedrock and has imparted a marked, northeast-southwest-trending structural grain within the bedrock.

The OU-2 study area is nearly entirely underlain by the PreCambrian to Cambrian age Marburg Schist (Figure 2.4), which is also mapped (in Maryland) as the Babylon Phyllite Member of the Marburg Formation. The Marburg Schist is a fine-grained, bluish-gray to silvery-green schist composed chiefly of muscovite, chlorite, albite, and quartz. Interbedded quartzites are common, especially in the upper part of the formation. Zones containing ottrelite and pyrite also may occur locally.

The dominant structural feature within the Marburg Schist is the pervasive schistosity (cleavage) that parallels the major structural grain of the province. The schistosity produces a planar fabric and is marked by closely spaced, nearly vertical, parallel partings or openings within the bedrock that strike at north 60 degrees east and dip at 80 degrees south.



SOURCE: PA. GEOLOGICAL SURVEY PRELIMINARY GEOLOGIC MAP SERIES

FIGURE 2-4

GEOLOGIC MAP
KEYSTONE LANDFILL SITE
ADAMS COUNTY, PENNSYLVANIA

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Fractures are common within the Marburg Schist. The regional fracture pattern is dominated by a fracture set that is oriented parallel to subparallel to the schistosity and the regional structural grain. These fractures tend to be fairly large and laterally continuous. A second fracture set consists of smaller, less continuous fractures that trend discordant to the schistosity and strike at approximately north 10 degrees east to north 40 degrees east. In general, the fractures tend to either close rapidly with depth or be filled by secondary mineralization. Most references commonly limit the effective (open) depth of the fractures to a subsurface depth of about 200 feet.

The crystalline rocks of the Marburg Schist are overlain by a mantle of saprolite that has formed by the in-place chemical weathering of the bedrock. The saprolite tends to retain many of the structural features of the parent rock. The thickness of the saprolite in the Piedmont Province is variable; the average thickness is approximately 45 feet.

The Cambrian age Antietam and Harpers Formations (undivided) occur approximately 2,300 feet northwest of the site (Figure 2.4). The contact between these formations and the Marburg Schist parallels the structural grain of the province. The Antietam Formation is composed of fine-grained quartzite and quartz schist. The Harpers Formation is composed of coarser-grained phyllite and albite-mica schist. These formations are often mapped together because of their lithologic similarities.

2.3.2 General Site Geology

The results of previous site investigations have revealed that the site-specific geology is similar to the regional geology. The lithology and structure of the Marburg Schist have been noted in the field observations and drilling logs constructed during the drilling of numerous boreholes and bedrock cores.

The Marburg Schist locally is composed of a fine-grained, finely laminated grayish-green to grayish-blue chloritic schist. Disseminated pyrite is widespread. Calcareous and quartzitic zones were also penetrated. The calcareous zones typically occurred as laminae or thin beds containing euhedral carbonate crystals. The quartzitic zones typically were oriented parallel to the schistosity but occasionally cut across the schistosity at high angles.

The typical vertical profile at the site consists of sequences of soil, saprolite, and weathered bedrock underlain by fresh bedrock. The contacts between these units are gradational. The thickness of the soil and saprolite is highly variable and apparently dependent on topography and position relative to fractures.

The soil at the site and the surrounding area is typified by a variety of well-drained channery loams an silt loams that contain rock fragments and silt-size and clay-size micas derived from the underlyir saprolite.

The saprolite is described as a basically non-competent, clayey soil having a visible relict rock structur that contains remnant schist and quartz fragments. The saprolite grades downward to a more competen finely laminated but very soft and "crumbly" weathered bedrock that parts along foliation planes an displays iron staining on foliation and fracture surfaces. The contact with the underlying fresh bedrock i reported to be gradational and to occur over several feet.

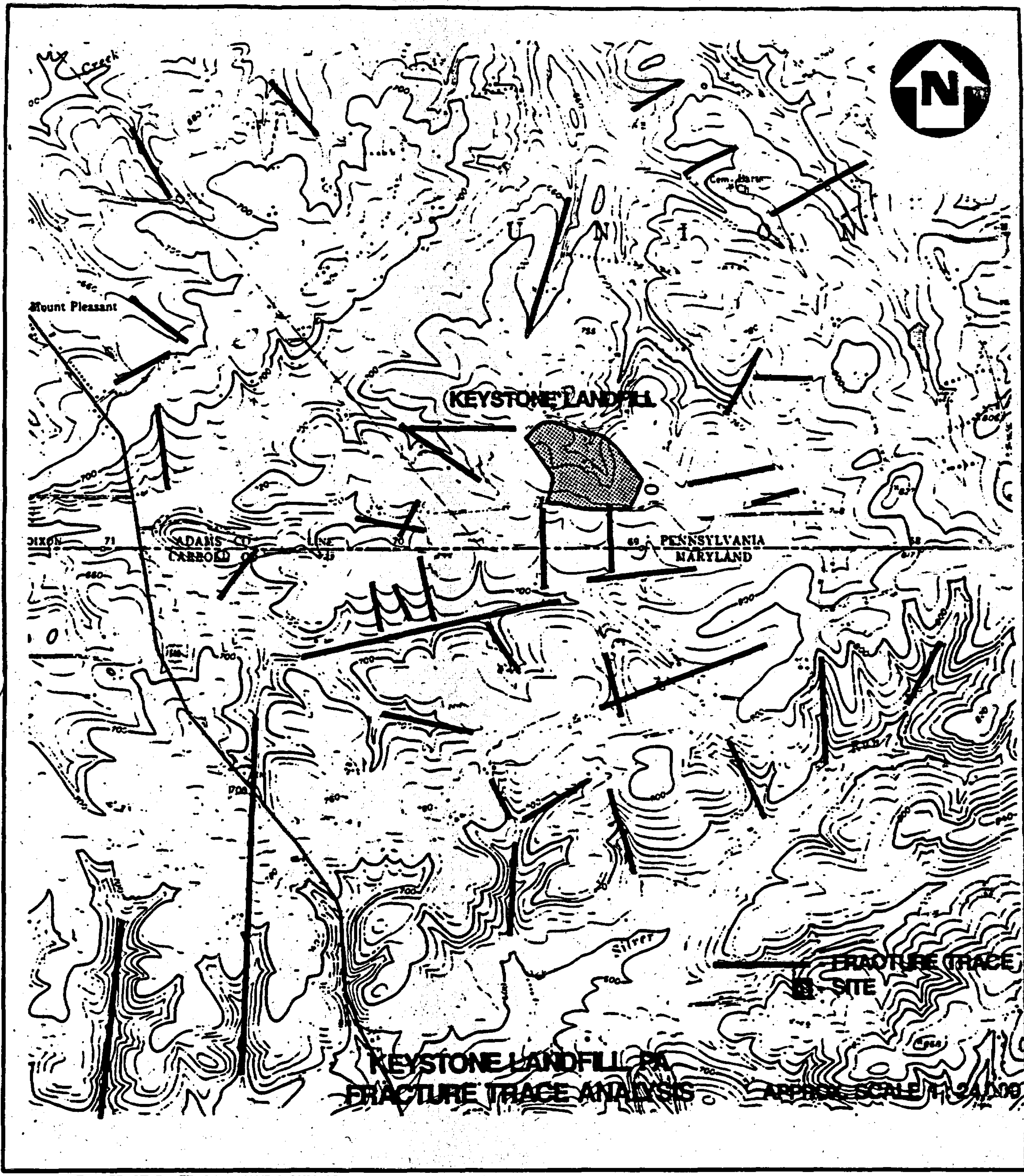
The Marburg Schist locally contains abundant fractures. The fractures were either observed directly in roc cores or their presence was inferred from secondary evidence such as secondary mineralization or iro oxide staining on drill cuttings. Fractures were encountered at subsurface depths of greater than 200 fee but were much more common at shallower depths. The fractures tend to close with increasing depth an were commonly filled by secondary mineral deposits.

Several fracture trace analyses and surface geophysical (electrical) surveys have been performed durin the previous site investigations in order to optimize monitoring well locations through the identification c delineation of potentially preferred avenues for groundwater movement. The results of these studies h confirmed the regional observation that the structural trends (such as the schistosity and fractures) are nc random but occur in preferred and somewhat predictable orientations.

A fracture trace analysis has been performed for the OU-2 investigation in order to further investigate th nature of groundwater flow within the study area and to optimize the location of additional monitoring wells to be installed. This study analyzed fracture traces occurring within a two-mile radius of the landfill. A tota of 38 fracture traces were identified (Figure 2.5). Most of the fracture traces occurred along straight strean segments. Two general fracture trace orientations were noted:

- Fracture traces whose orientation was closely parallel to the major structural grain and th bedrock schistosity (11 traces).

- Fracture traces oriented at various angles to the regional structural grain (27 traces These fractures were dominantly located along small streams.



SOURCE: EPA FRACTURE TRACE ANALYSIS MAY 1994

FIGURE 2-5

FRACTURE TRACE LOCATION MAP
KEYSTONE LANDFILL SITE
ADAMS COUNTY, PENNSYLVANIA

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2.4 HYDROGEOLOGY

2.4.1 Regional Hydrogeology

Groundwater flow in the Piedmont Physiographic Province generally occurs within a complex, two-component groundwater system. The upper flow system consists of the soil, saprolite, and shallow weathered bedrock, where groundwater flows within the granular weathered material and the relict structure (fractures, cleavage planes) of the soil and saprolite and within the secondary openings (fractures, cleavage planes) of the bedrock. The lower flow system consists of the fractured bedrock where groundwater flow is restricted to the secondary openings (fractures, cleavage planes) within the bedrock. There is little groundwater circulation or storage below the depth of open fractures within the bedrock. The physical properties of the saprolite (e.g., thickness, porosity, permeability) are the dominant factors controlling the occurrence of groundwater because the saprolite contains most of the groundwater stored in the crystalline rock aquifers.

Numerous studies and reports have investigated the occurrence and vertical distribution of groundwater zones within the Marburg Schist. These studies have concluded that most of the available groundwater within the formation occurs at relatively shallow depths within the saprolite and that the groundwater available from the fractured bedrock is largely restricted to the upper 150 to 200 feet of the aquifer. Wells are typically drilled below this zone to increase the storage volume of the well; these wells usually do not intersect any additional significant water-bearing fractures or zones.

Groundwater flow systems within the Piedmont Province are generally small, and the groundwater flow paths are generally relatively short. The orientation of the water table is often a subdued replica of the surface topography; the prevailing groundwater flow is from the upland areas to the lowland areas. Ridges and hilltops typically are underlain by relatively unfractured and impermeable bedrock, and they tend to be water-table divides. Perennial streams that occur in the lowlands and are underlain by more highly fractured bedrock tend to function as discharge points for groundwater.

2.4.2 Site Hydrogeology

The results of previous investigations have revealed that the site-specific hydrogeology is generally similar to the regional hydrogeology. The occurrence and distribution of water-bearing zones have been noted in the field observations and drilling logs constructed during the drilling of numerous boreholes and bedrock cores. The vertical and lateral distribution of hydraulic head within the aquifer has been determined and measured through the installation of numerous on-site and off-site monitoring wells and piezometers. The groundwater flow characteristics have been determined through the construction of water-elevation contou maps and through the conduct and evaluation of multiple pumping tests.

2.4.2.1 Groundwater Occurrence and Distribution

Most of the available groundwater at the site occurs at relatively shallow depths (generally less than 45 feet) and is contained in the saprolite. Well development logs indicate that the wells completed within the saprolite and the shallow bedrock produce significantly more water than the wells completed in the deepe bedrock. Most of the significant water-bearing zones within the bedrock occur at depths of less than 130 to 150 feet.

The groundwater within the saprolite and the shallow fractured bedrock zones is in hydraulic communication, and these zones act as a common aquifer. This conclusion is supported by the observation that the difference in hydraulic heads for monitoring wells completed within these zones at a single cluster location is typically very small and the observation that water levels in the shallow wells respond to the pumping of the intermediate wells.

The vertical distribution of groundwater contaminants both on site and off site also supports the definition of the saprolite and the shallow fractured bedrock as a common, interconnected aquifer. For the off-s areas east and southwest of the landfill, groundwater contamination in monitoring wells has bee documented in the shallow bedrock at each well cluster location where groundwater contamination has been documented in the saprolite and/or at the saprolite/bedrock interface. This suggests that there are no barriers to groundwater flow between these zones.

The groundwater within the deeper bedrock zones (below a depth of about 150 feet) may or may not be in hydraulic communication with the shallower groundwater. The monitoring wells completed within this zone typically have a very low yield and recharge very slowly. This may be indicative of the low storage capacities and low permeabilities of the fractures at this depth, however, and does not preclude the potential for shallow groundwater contamination to eventually migrate to this zone..

In theory, the major fracture zones are the most likely location for a vertical interconnection between the water-bearing zones to occur. The existing monitoring wells have been located in fracture zones. An evaluation of the distribution of hydraulic head within well clusters containing a deep bedrock well, however yields inconclusive results. Generally, the static water elevation of the deep well is fairly close to the elevations of the intermediate and/or shallow wells. At some cluster locations, however, the static wate elevation of the deep well is more than 100 feet below the elevation of the shallower wells (e.g., Clus "G" and Maryland wells 1 through 3). Apparently, at some locations, the fractures intersecting the shallov groundwater zone remain open through the deeper zone or intercept other fractures that do, thereby interconnecting the various water-bearing zones. At other locations, the fractures penetrated by the deep well are not in hydraulic communication with fractures open to the shallower groundwater zone.

2.4.2.2 Groundwater Flow Characteristics

Groundwater flow in the area is influenced by the topography and by the hydrogeologic properties of the saprolite and the bedrock. In general, the groundwater occurs under unconfined conditions and flows from the recharge areas in the topographic highs to the discharge areas in the topographic lows.

The groundwater flow directions within the aquifer, as inferred from the distribution of hydraulic head and the construction of multiple static-water elevation contour maps, are dominantly from the recharge areas of the topographic highs to the discharge areas of the topographic lows. The landfill occupies an area of recharge along a northwest-southeast-trending topographic divide that also forms a groundwater divide. The prinicipal groundwater flow directions north of the divide are north to northeast. South of the divide, the groundwater flows primarily to the southwest.

Groundwater flowing to the south from the landfill is reported to discharge into the tributary to Piney Creek. The hydraulic heads measured in monitoring wells installed north and south of this tributary (locations "C" and "D") appear to indicate that the stream is serving as a discharge point for groundwater, at least to the aquifer depths monitored by these wells (a subsurface depth of approximately 100 feet). In addition, the vertical hydraulic gradient for well cluster "C," which is located adjacent to the tributary, is oriented upward for all wells, including the deep (236 feet) well. This further supports the conclusion that the valley occupied by the tributary to Piney Creek is a discharge zone for groundwater. Two reports, however, indicate that some of the deeper groundwater flowing south from the landfill may be intercepted by supply wells south of the tributary or may be ultimately discharged into the Silver Run stream valley.

Groundwater flowing to the north and east of the landfill is reported to discharge to springs and to the tributary to Conewago Creek. Potentiometric data indicate that at least a portion of the groundwater within the shallow aquifer is discharging to the tributary. The extent to which this tributary serves as the discharge point for all the shallow groundwater and the deeper groundwater, however, is uncertain due to the lack of data on the opposite (eastern) side of the tributary. The vertical hydraulic gradient for well cluster "A," which is located near (but not immediately adjacent to) the tributary, is oriented downward for all wells. This may indicate that there is still the potential for groundwater within the valley to migrate to the deeper portions of the aquifer.

The Marburg Schist has very low primary hydraulic properties. Secondary flux in the foliation and fractures is the major flow mechanism. The structural grain of the schist imparts an overall marked anisotropy to the groundwater flow within the area. Multiple pumping tests have revealed that the drawdown parallel t the strike of the structural grain is typically much greater and more laterally extensive than the drawdowr perpendicular to the schistosity. The preferred groundwater flow direction in the bedrock is dominantly ir a northeast-southwest direction or parallel to the schistosity or cleavage planes of the bedrock.

Fractures that cut discordantly across the cleavage may locally deflect or alter the groundwater flow trends discussed above. For example, two pumping tests conducted immediately east of and adjacent to the landfill and within 500 feet of one another had markedly different results. In one test, a well pumped a approximately five gallons per minute (gpm) caused linear drawdown trends similar to those discussec above. In the second test, however, a well pumped at approximately 30 gpm caused a relatively wide anc radial drawdown response. Calculated transmissivities were within an order of magnitude in directions both parallel and perpendicular to the principal direction of schistosity. Apparently, the second pumping wel intercepted a significant fracture or series of fractures (as supported by its higher yield) that permitted the flow of groundwater across the dominant structural grain of the bedrock. This is significant because i indicates that relatively large quantities of groundwater in the area may locally travel for a significan distance in a direction(s) discordant to the regional groundwater flow trends.

2.5 SUMMARY: GEOLOGY AND HYDROGEOLOGY

The geological and hydrogeological points discussed in the previous sections are summarized below.

- The majority of the study area is underlain by the Marburg Schist. The Marburg Schist displays a pervasive schistosity (cleavage) that parallels the major northeast-southwest structural grain of the Piedmont Province.

- The Marburg Schist within the study area is overlain by a mantle of soil and weatherec bedrock or saprolite. The saprolite tends to become more competent with depth anc contains relict structure. The thickness of the saprolite is variable and appears to be dependent on topographic position and position relative to major bedrock fractures.

- Fractures are common within the Marburg Schist. The regional fracture pattern i dominated by a fracture set that is oriented parallel to subparallel to the bedroc schistosity. A second fracture set consists of smaller, less continuous fractures that tren discordantly to the bedrock schistosity. Numerous fractures belonging to both fracture s have been identified in the immediate study area adjacent to the site. The fractures tend to close with increasing depth.

- Groundwater flow within the area generally occurs within a complex, two-component system. The upper flow system consists of the soil, saprolite, and shallow weathered bedrock. The lower flow system consists of the deeper, fractured bedrock. Groundwater flows within the interstitial openings and relict structure (fractures, cleavage planes) of the soil and saprolite and within the fractures and cleavage planes of the bedrock.

- Most of the available groundwater at the site occurs at relatively shallow depths (generally less than 45 feet) within the saprolite or at the saprolite/bedrock interface. Most of the significant water-bearing zones within the bedrock occur at depths of less than 130 to 150 feet, although water-bearing fractures have been encountered at depths of greater than 200 feet.

- The vertical distributions of hydraulic head indicate the potential for a hydraulic interconnection between the shallow and deep groundwater zones at some locations. The major fracture zones are believed to serve as the principal conduits for the vertical migration of the groundwater.

- The lateral groundwater flow paths within the bedrock are typically influenced by the bedrock schistosity. The fractures have the potential to transmit significant volumes of groundwater in directions either concordant or discordant to the local and regional groundwater flow patterns.

- The groundwater occurs under unconfined conditions. The groundwater typically flows from the recharge zones in the topographic highs to the discharge zones in the topographic lows. The orientation of the water table tends to be a subdued reflection of the surface topography. Thus, the general direction or potential for groundwater flow (given a pathway or conduit such as a cleavage plane or a fracture) may be estimated by determining the direction of surface water flow at that direction.

- Streams and ridges within the study area typically serve as local discharge and recharge points, respectively, for groundwater. The majority of the groundwater flowing from the site probably discharges to the local streams and springs. The extent to which the groundwater may be entering a deeper aquifer zone and bypassing the local discharge point is uncertain.

2.6 GROUNDWATER USE

Residents within the OU-2 study area rely on groundwater obtained from private wells and springs for their water supply. There are approximately 40 or more residential wells located within one mile of the site. These wells range in depth from shallow, dug wells to drilled wells over 400 feet deep. The majority of these wells, with the exception of those located in the far northern and northwestern portions of the study area, are completed in the Marburg Schist. The median yield of this formation in Adams County (based on very limited data) is reported to be nine gpm.

2.7 SURFACE WATER HYDROLOGY

The Keystone Sanitation landfill straddles a topographic ridge and is situated on a surface water drainage divide (Figure 2.2). Drainage from the site north of the divide discharges via three small drainage pathways (including the drainage from the on-site retention pond) into the unnamed tributary to Conewago Creek located 100 feet north of the site. Drainage from the site south and southwest of the divide is via intermittent streams into the unnamed tributary to Piney Creek, located approximately 2,000 feet south of the site in Maryland. Numerous small springs within the study area discharge to surface water bodies.

2.8 ECOLOGY

The Keystone Site is located in a rural agricultural area in south-central Pennsylvania, near the Maryland border. The area is a mixture of agricultural fields, meadows, hardwood forests, wetlands, and small streams. The streams in the area are typically shallow and originate from surface drainage or from groundwater springs. Most of the surface water north of the landfill drains to Conewago Creek, and surface water south of the landfill drains to Piney Creek. Stream depths in the study area typically range from two to six inches.

Agricultural fields and meadows are the dominant wildlife habitats of the area. The less extensive forested areas occur primarily along the drainageways, although a few scattered woodlots are present in other areas surrounding the site. Wetlands are limited to areas surrounding surface seeps and along streams. Wildlife species that typically inhabit farmland and open rural areas are likely to be found in the site vicinity. No state or federal endangered or threatened species are known to occur in the study area.

The region around the site has a mild climate with long warm summers and short cool winters. Temperatures range from about 85°F in summer to 25°F in winter. About 41 inches of rain fall annually, with approximately half falling between April and September.

SECTION 3.0

3.0 SCOPING OF REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

This work plan has been developed to present the technical scope of work for OU-2 of the Keystone Sanitation Landfill Site. The scope of work must be adequate to meet the focused objectives of the RI/FS, which are to characterize the nature and extent of off-site contamination attributable to the Keystone Sanitation Landfill, to assess any unacceptable risks posed by such contaminants, and to develop and evaluate remedial alternatives to address any unacceptable risks.

The first part of this section presents a summary of existing data for the site. These data are then used to develop a preliminary risk assessment that briefly examines potential exposure pathways and evaluates public health risks. Applicable state and federal regulations and guidelines are used in conjunction with the results of the preliminary risk assessment to help determine appropriate remedial technologies. In the evaluation of risks to human health and environment and of the remedial technologies, data gaps are identified and further developed as specific investigation objectives. The quantity of data to be collected and the associated quality requirements (data quality objectives) are defined in the final portions of this section.

3.1 SUMMARY OF EXISTING DATA

Several agencies/private contractors conducted environmental sampling in the area around the Keystone Sanitation Landfill Site between 1981 and 1994. The numerous samplings of monitoring wells, residential wells, surface water, sediment, and soil have resulted in a large volume of analytical data. In December 1993, HNUS submitted to EPA a review of analytical results from groundwater sampling conducted by the following parties:

- State of Maryland
- Williams-Russell and Johnson (WR&J) (under contract to EPA)
- HNUS FIT (under contract to EPA)
- Roy F. Weston TAT (under contract to EPA)

Sampling events conducted by these parties are briefly described below. Please note that this is not meant to be a comprehensive summary of all data collected by all agencies/contractors or private citizens. The review of other data will be performed as part of the RI/FS as described in Section 4.1.2 of this work plan.

3.1.1 Groundwater

The Maryland Department of Health and Mental Hygiene (MD DHMH), in June 1986, published a study entitled "Keystone Landfill Maryland Monitoring System Investigation and Report." This investigation included six rounds of sampling conducted over a one-year period (April 1985 to April 1986) of nine monitoring wells and seven residential wells. As part of this study, data from other sampling events were compiled, including earlier Maryland sampling results (1981 to 1985) and PADER analyses (April 1986).

From May through July 1988, MDE collected samples from 26 residential wells located south of the site in Maryland. The samples were analyzed by MD DHMH for VOCs. Analytical results showed detectable levels of VOCs in two residential wells. These results were reported in March 1989 in the MDE document "Report of the Investigation of the Occurrence of Volatile Organic Chemicals in Groundwater in the Humbert Schoolhouse Road Area, Northern Carroll County, Maryland."

From May 1989 to April 1990, WR&J conducted field work for an RI at the site. As part of the RI, the analytical data were obtained from 35 monitoring wells and 15 residential wells.

In May 1991, HNUS FIT conducted a field trip at the site. FIT sampled 30 residential wells for VOCs.

Weston TAT collected samples from 36 residential wells during the week of April 19, 1993. TAT resampled 15 of these wells for specific target compounds in October 1993. During the week of February 21, 1994, TAT collected an additional 30 residential well samples.

3.1.1.1 Monitoring Wells

Table 3-1 summarizes analytical results of monitoring well samples obtained from the studies discussed in Section 3.1.1. The listed compounds are the contaminants of concern for the groundwater medium as identified in the ROD for OU-1. Sampling will be conducted during OU-2 RI/FS field activities to further define the nature and extent of groundwater contamination attributable to the site in off-site monitoring wells.

DRAFT

TABLE 3-1
MONITORING WELL ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE

Compound/Analyte	Range of Detected Concentrations (ppb)	Number of Wells With Detected Concentrations
antimony	60 - 6-	2
barium	40 - 1,930	5
beryllium	1.2 - 1.2	1
cadmium	0.6 - 26	8
chromium	[4.0] - 658L	24
cobalt	1.3 - 246	0
lead	[2.0] - 109	18
manganese	1 - 170,000	8
mercury	0.2J - 2.5	4
nickel	11 - 1,040L	15
selenium	[1.0]L - [4.7]	2
vanadium	4.7 - 24	5
acetone	7J - 69	3
benzene	2 - 8	4
carbon disulfide	3	1
chloroethane	3J - 18	4
1,1-dichloroethane	1 - 124	7
1,1-dichloroethene	1 - 206	3
1,2-dichloroethene (total)*	1 - 223	8
dichlorodifluoromethane	4 - 48	7
tetrachloroethene (PCE)	1.8 - 250	10
1,1,1-trichloroethane	1 - 1,300	10
trichloroethene (TCE)	0.7 - 120	8
vinyl chloride	3 - 107	3

KEY: * - Includes reported concentrations for cis- and trans- isomers.
J - Estimated value.
L - Analyte present but may be biased low. Actual value is expected to be higher.
[ ] - Analyte present but near the instrument detection limit (IDL). As values approach the IDL, the quantitation may not be accurate.

TABLE 3-1
MONITORING WELL ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 2

Compound/Analyte	Range of Detected Concentrations (ppb)	Number of Wells With Detected Concentrations
benzo(g,h,i)perylene	---	0
benzoic acid	3J - 4J	3
bis(2-ethylhexyl) phthalate	3J - 7J	6
chrysene	---	0
dibenz(a,h)anthracene	4J	1
diethyl phthalate	2J	1
indeno(1,2,3-cd)pyrene	7J	1
aldrin	0.021J - 0.16	2
4,4-DDT	0.04J - 0.35	6

KEY: J - Estimated value.

3.1.1.2 Residential Wells

Table 3-2 summarizes analytical results of residential well sampling obtained from the studies discussed in Section 3.1.1. The listed compounds are the contaminants of concern for the groundwater/residential well medium as identified in the ROD for OU-1. Sampling will be conducted during RI/FS field activities to further define the nature and extent of groundwater contamination attributable to the site in residential wells.

3.1.2 Surface Water and Sediments

The June 1986 MD DHMH report contained analytical data from six surface water locations. Four surface water samples were collected by MDE in May 1988 and included as part of the March 1989 report. The RI conducted in 1989 and 1990 included the collection and analysis of 18 surface water samples and 10 sediment samples. Tables 3-3 and 3-4 summarize analytical results of surface water and sediment sampling obtained from the studies conducted by the state of Maryland and from the RI. The listed compounds are the contaminants of concern for the surface water and sediment media as identified in the OU-1 ROD. Sampling will be conducted during OU-2 RI/FS field activities to further define the nature and extent of possible surface water and sediment contamination attributable to the site.

3.1.3 Soil

Two soil samples, one from the upper few inches of soil and the other from 12 to 18 inches below the ground surface, were collected at nine on-site and 15 off-site locations as part of the WR&J RI. Table 3-5 summarizes analytical results of soil sampling obtained from the WR&J study. The listed compounds are the contaminants of concern for the soil medium as identified in the OU-1 ROD. Off-site soil sampling will be conducted during the OU-2 RI/FS field activities to investigate the potential impact of runoff and wind-carried contamination from the spray irrigation well as a contaminant transport mechanism.

3.2 PRELIMINARY RISK ASSESSMENT

This section presents a preliminary risk assessment of the potential public health and environmental risks associated with exposure to contaminated environmental media within the off-site study area. The assessment focuses on chemicals that have been previously identified as potential hazardous substances of concern associated with the site. The RI report addressed contamination and risks at or associated with

TABLE 3-2
RESIDENTIAL WELL ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE

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Compound/Analyte	Range of Detected Concentrations (ppb)	Number of Wells With Detected Concentrations
antimony	35 - 59	13
barium	5.2J - 1,440	42
beryllium	—	0
cadmium	2 - 6	8
chromium	3 - [4.1]	4
cobalt	[4.9] - [10.3]	6
copper	8.8J - 4,820	55
lead	2J - 126	37
manganese	[1.4] - 4,100	48
mercury	[0.1] - 0.59	5
nickel	[4.5] - [12.3]	13
selenium	—	0
vanadium	[2.8]	1
zinc	3.7J - 3,300	59
acetone	11.7	1
benzene	3.3	1
carbon disulfide	0.1J	1
chloroethane	—	0
1,1-dichloroethane	1 - 19	3
1,1-dichloroethene	1 - 1	1
1,2-dichloroethene (total)*	1.9 - 21	4
4-methyl-2-pentanone (MEK)	3 - 3	1
dichlorodifluoromethane	—	0
tetrachloroethene (PCE)	0.02J - 27	7
1,1,1-trichloroethane	0.03J - 17	7
trichloroethene (TCE)	0.2 - 4.5	5
vinyl chloride	0.002J - 4	2

KEY: J - Estimated value.
[ ] - Analyte present but near the IDL. As values approach the IDL, the quantitation may n be accurate.

TABLE 3-2
RESIDENTIAL WELL ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 2

Compound/Analyte	Range of Detected Concentrations (ppb)	Number of Wells With Detected Concentrations
benzo(g,h,i)perylene	—	0
benzoic acid	—	0
bis(2-ethylhexyl) phthalate	1J	1
2-chlorophenol	0.3 - 0.4	10
chrysene	—	0
dibenz(a,h)anthracene	—	0
diethyl phthalate	0.3J - 0.4J	4
dimethyl phthalate	0.4J	1
di-n-butyl phthalate	0.5J - 29	13
indeno(1,2,3-cd)pyrene	—	0

KEY:
J - Estimated value.

TABLE 3-3
SURFACE WATER ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE

Compound/Analyte	Range of Detected Concentrations (ppb)	No. of Samples With Detected Concentrations
barium	200	1
chromium	13.4	1
copper	10 - 2,040	7
lead	[1.1] - 18.9K	13
manganese	10 - 3,700	4
mercury	0.3 - 7.8	5
selenium	[1.3]	1
vanadium	14	2
zinc	[9.4] - 2,050	23
1,1-dichloroethane	0.3 - 0.7	2
tetrachloroethene (PCE)	2 - 5	3
1,1,1-trichloroethane	2 - 5	3

KEY:

K - Analyte present but reported value may be biased high. Actual value is expected to be lower.

[ ] - Analyte present but near the IDL. As values approach the IDL, the quantitation may not be accurate.

TABLE 3-4
SEDIMENT ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE

Compound/Analyte	Range of Detected Concentrations (ppb)	Number of Samples With Detected Concentrations
barium	32 - 187	8
beryllium	[0.46] - 2.1	8
lead	16.6J - 200J	10
manganese	296 - 2,580	8
silver	1.7	1
acetone	3 - 12	8
methylene chloride	2 - 29	7
4-methyl-2-pentanone	4 - 7	8
bis(2-ethylhexyl) phthalate	52J - 130J	3

KEY:
- J - Estimated value.
- [ ] - Analyte present but near the IDL. As values approach the IDL, the quantitation may not be accurate.

TABLE 3-5
SOIL ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE

Compound/Analyte	Range of Detected Concentrations (ppb)	Number of Samples With Detected Concentrations
antimony	[6.0] - 8.7L	3
manganese	231 - 4,420	36
mercury	0.1 - 1.2	6
selenium	[0.47]J - [0.81]J	2
silver	4.2	1
1,1-dichloroethane	2J	2
1,2-dichloroethene (total)*	6J	1
2-hexanone	2 - 13	7
4-methyl-2-pentanone	3 - 5	18
tetrachloroethene (PCE)	43	1
anthracene	14J - 120J	2
benzo(a)pyrene	19J - 180J	6
benzo(b)fluoranthene	22J - 200J	8
benzo(g,h,i)perylene	100J	1
benzo(k)fluoranthene	13J - 160J	5
benzoic acid	23J - 240J	8
bis(2-ethylhexyl) phthalate	10 - 1,300	36
butylbenzyl phthalate	35J	1
chrysene	19J - 89J	9
dibenz(a,h)anthracene	160J	1
diethyl phthalate	15J - 160J	4
dimethyl phthalate	26J - 88J	3
di-n-butyl phthalate	20 - 250	34
di-n-octyl phthalate	5J - 140J	13
fluoranthane	14J - 200J	14
indeno(1,2,3-cd)pyrene	110J	1

TABLE 3-5
SOIL ANALYTICAL DATA SUMMARY
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 2

Compound/Analyte	Range of Detected Concentrations (ppb)	Number of Samples With Detected Concentrations
/phenanthrene	17J - 160J	6
pyrene	12 - 180	13
dieldrin	2.2J - 12J	5

KEY:

J - Estimated value.
L - Analyte present but may be biased low. Actual value is expected to be higher.
[ ]- Analyte present but near the IDL. As values approach the IDL, the quantitation may not be accurate.

the site; however, the OU-1 RI did not comprehensively address issues related to potential off-site contamination. This preliminary off-site risk assessment is based upon validated OU-1 data (as listed in the preceding section), although available sampling results were examined from 1984 to present. It should be noted that some of the existing data are of uncertain quality because of the associated sampling procedures, analytical methods, and unknown validation status of the data. In addition, the historical sampling data contain several inconsistencies and data gaps: for example, trace-level detections of several volatile compounds that were reported in only one out of several topographically related wells and/or during only one isolated sampling event out of as many as 20 samplings of a given well and sporadically reported compounds that are commonly found as laboratory contaminants or artifacts. Although data from previous EPA investigations are considered to be of known quality, in order to resolve questions pertaining to potential off-site contamination, a more thorough assessment will be performed during the OU-2 RI/FS.

The risk assessment process has several components. The first component is the Hazard Assessment, which is comprised of the selection of indicator compounds that adequately represent the site conditions and an evaluation of their toxicity. The second component is an assessment of the potential exposure pathways. Exposure doses can then be estimated by making assumptions about hazardous substance concentrations at the point of exposure and about exposure duration. The third component is a toxicity assessment that presents toxicity criteria, regulatory standards, and health-based guidelines for hazardous substances of concern. Finally, potential carcinogenic and noncarcinogenic risks can be estimated (risk characterization) by using published toxicological information. Because this is a preliminary risk assessment, the risk characterization presented in Section 3.2.4 is more qualitative than quantitative. A more quantitative risk assessment will be conducted using data obtained during the RI because additional investigation is needed to characterize and substantiate the extent of off-site contamination attributable to the site.

3.2.1 Hazard Assessment

3.2.1.1 Indicator Chemical Selection

A comprehensive list of indicator compounds (i.e., chemicals of concern) will be selected for the RI risk assessment based on current EPA guidance. Indicator chemicals are intended to be representative of site conditions and potential health risks. They are selected based upon factors such as toxicity, frequency of detection, and environmental mobility, etc. Chemicals of concern are the basis for selection of analyzed parameters/fractions requiring quantitative chemical analysis in the RI/FS.

Because the OU-2 RI/FS will address off-site contamination related to the site, this preliminary risk assessment will focus on the hazardous substances of concern previously delineated in EPA's 1990 ROD and the 1990 Keystone RI report. Although the off-site contamination and potential migration pathways were not fully characterized in the 1990 RI report, the selection of hazardous substances of concern was based upon validated data. In addition, other existing data (presented in Section 3.1) reveal that no additional contaminants (other than naturally occurring minerals/essential nutrients) were consistently reported in the 1990 RI and other sampling studies so as to suggest a consideration of the hypothesis of off-site migration of additional chemicals. It is anticipated that several or most of the previously selected compounds will continue to be among the principal chemicals of concern for the OU-2 risk assessment. However, the list of indicator chemicals could be augmented or reduced during OU-2 RI/FS based upon an evaluation of additional data that will include more thorough background sampling, lower detection limits and better data quality for residential well sampling, and a more thorough temporal and spatial characterization of the extent of contamination. These data will be evaluated during the OU-2 risk assessment so that, if other patterns of contamination are suggestive of off-site migration of hazardous substances, consideration will be given for including additional chemicals of concern as appropriate.

In the OU-1 RI/FS, chemicals of concern were selected separately for each medium. In evaluating the applicability of these categories to the OU-2 risk assessment, it was assumed that any chemicals of concern from OU-1 monitoring wells or residential wells would be included in the OU-2 groundwater evaluation. The surface water and sediment chemicals of concern were also combined together into one list in defining the preliminary OU-2 chemicals of concern. However, because of the possibility that the OU-2 investigation will reveal contaminants in surface water/sediment or surface soil that are attributed to groundwater (spring discharges or spray irrigation system), the indicator chemicals for these pathways may be augmented to include other chemicals from the groundwater pathway or be reduced if multiple rounds of sampling do not reveal certain hazardous substances. Overall, this approach will also be applied to all media during preliminary data evaluation during the OU-2 RI/FS. The following table (Table 3.6) lists the preliminary chemicals of concern for each medium [groundwater (GW), which includes both residential and monitoring wells, surface water/sediment (SW/SD), and surface soil (SS)].

3.2.1.2 Toxicological Profiles

Because 37 organic and 15 inorganic chemicals are among the preliminary chemicals of concern, the reader is referred to the OU-1 RI report for a brief qualitative discussion of toxicological human health effects for each of these chemicals. (Up-to-date carcinogenic and non-carcinogenic criteria are presented in Section 3.2.4 of this work plan.) Note that vinyl chloride and several other halogenated VOCs are classified as potential carcinogens, and non-carcinogenic effects may result for both organic and inorganic chemicals of concern.

TABLE 3-6
PRELIMINARY CHEMICALS OF CONCERN
KEYSTONE SANITATION LANDFILL SITE

Compound/Element	Analytical Fraction	GW	SW	SD	SS
Volatiles					
vinyl chloride		X			
chloroethane		X			
methylene chloride			X	X	
1,1-dichloroethene		X			
1,1-dichloroethane		X	X		X
1,2-dichloroethene (total)		X			X
1,1,1-trichloroethane		X	X		X
trichloroethene		X			X
tetrachloroethene		X	X		X
dichlorodifluoromethane		X			
benzene		X			
carbon disulfide		X			
acetone		X		X	
4-methyl-2-pentanone		X		X	X
2-hexanone					X
Semivolatiles					
2-chlorophenol		X			
benzoic acid		X			X
dimethyl phthalate		X			X
diethyl phthalate		X			X
di-n-butyl phthalate		X			X
bis(2-ethylhexyl) phthalate		X		X	X
butylbenzyl phthalate					X
di-n-octyl phthalate					X
fluoranthene					X
pyrene					X
phenanthrene					X
anthracene					X
chrysene		X			X
benzo(b)fluoranthene					X
benzo(k)fluoranthene					X

TABLE 3-6
PRELIMINARY CHEMICALS OF CONCERN
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 2

Compound/Element	Analytical Fraction				
		GW	SW	SD	SS
Semivolatiles					
benzo(a)pyrene					X
indeno(1,2,3-c,d)pyrene		X			X
dibenz(a,h)anthracene		X			X
benzo(g,h,i)perylene		X			X
Pesticides					
dieldrin					X
aldrin		X			
4,4'-DDT		X			
Metals					
antimony		X			X
barium		X	X	X	
beryllium		X		X	
cadmium		X			
chromium		X	X		
cobalt		X			
copper		X	X		
lead		X	X	X	
manganese		X	X	X	X
mercury		X	X		X
nickel		X			
selenium		X	X		X
silver				X	X
vanadium		X	X		
zinc		X	X		

GW - groundwater (residential and monitoring wells)
SW/SD - surface water and sediment
SS - surface and subsurface soil

Of the contaminants detected in groundwater, VOCs are considered to be highly mobile. Chlorinated ethanes and ethenes were the predominant VOCs detected in the groundwater (i.e., they were detected most frequently and at more consistent levels for a given well).

3.2.2 Exposure Assessment

The second step in the risk assessment process is to identify actual or potential routes of exposure for human and environmental receptors and to characterize the likely magnitude of exposure. An exposure pathway has four elements:

- source and mechanism of release to the environment
- transport medium such as air or water
- point of receptor contact with the contaminated medium
- an exposure route (such as ingestion of drinking water) at the contact point

If one of these elements is missing, there is no exposure.

Sources of Contamination

The Keystone Sanitation Landfill Site contains unknown quantities and varieties of buried wastes, including general municipal refuse as a major component. The exact locations of wastes are unknown, and multiple low-volume sources could potentially be present within the landfill. In addition, the inactive groundwat spray treatment system is considered a potential source of contamination over the localized surface are that had been affected by this activity. The scope of work for the OU-2 RI will not delineate exact sources of contamination within the landfill but will establish and characterize actual or potential chemical migration to off-site locations.

As discussed in Section 3.1, contamination has been detected in the groundwater and soils near the perimeter of the site and, to a lesser extent, in surface water and sediment, although characterization of the extent of off-site hazardous substance migration is incomplete.

Contaminant Migration Pathways

The major contaminant transport pathways with a potential for human or environmental exposure attributable to the site are as follows:

- Contaminant leaching from source areas within the landfill (e.g., contaminated subsurface soils) to the groundwater upon infiltration of precipitation. The hydrologic gradients identified or suggested by previous studies support groundwater flow in a direction away from the land perimeter. VOCs with high water solubilities and low organic carbon partition coefficients (K_{oc}) are most amenable to such transport.

- Erosion of contaminated surface soils and dissolution of surficial contaminants with subsequent transport to local water bodies (e.g., creeks and springs) via overland runoff. In the area of the spray treatment system, contamination may have been introduced by the dispersion of groundwater contaminated with VOCs.

- Contaminant migration by groundwater discharge to surface water/sediments of local creeks.

Human/Environmental Exposure Pathways

Potential human and environmental exposure pathways identified under current or future land-use scenarios for this site include

- Ingestion of contaminated groundwater, dermal contact with contaminated groundwater while bathing, and inhalation of contaminants found in the groundwater while showering. (Groundwater was determined in the OU-1 RI to be the primary exposure pathway associated with human health risks.)

- Off-site dermal contact with surficial soils and incidental ingestion of off-site soil.

- Inhalation of contaminants volatilizing from off-site contaminated soil by off-site human receptors. Releases of VOC may be affected by the presence of landfill gases such as methane.

- Ingestion of/dermal contact with surface waters/sediments of creeks potentially contaminated by groundwater discharges to the surface waters or by overland runoff from the site. Ingestion of fish taken from creeks in the vicinity/downstream of the site.

- Ingestion of contaminated agricultural crops or livestock meat and/or milk raised in areas contaminated by the site, where significant bio-uptake might have occurred.

All of the preceding scenarios, except for crops and livestock bio-uptake, have been previously studied to some extent. However, because the OU-1 RI did not fully characterize potential off-site contamination attributable to the site, additional well installation, groundwater and residential well sampling, and surface sediment and water/soil sampling will more thoroughly characterize off-site environmental contamination.

3.2.3 Toxicity Assessment

The third step in the risk assessment process is to evaluate the relationship between the dose of compound (amount to which an individual or population is exposed) and the potential for adverse health effects resulting from exposure to that dose. Dose-response relationships provide a means by which potential public health impacts may be evaluated. Dose-response parameters (cancer slope factors, reference doses) are used in the risk characterization to estimate potential carcinogenic and noncarcinogenic risks.

Table 3-7 presents available dose-response parameters, as well as relevant regulatory standards or guidelines for all the compounds identified as preliminary chemicals of concern for this site. Presently, the only enforceable regulatory standards are the Maximum Contaminant Levels (MCLs) for public water supply systems promulgated under the Federal Safe Drinking Water Act (SDWA). Other relevant regulatory guidelines include the Ambient Water Quality Criteria (AWQCs), Maximum Contaminant Level Goals (MCLGs), and Health Advisories (HAs).

Table 3-7 also compares the historical range of concentrations of the organic and inorganic hazardous substances found in the groundwater in the vicinity of the site (either monitoring wells or residential wells) with the regulatory requirements. As shown in this table, MCLs were exceeded in one or more sampling events in monitoring wells or residential wells for vinyl chloride, 1,1-dichloroethene, 1,2-dichloroethene, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, benzene, and selected semivolatile compounds. MCLs were also exceeded for several metals; however, the significance of metals data is of concern due to inclusion of unfiltered sampling results reported in previous studies. Among the VOCs, vinyl chloride and benzene have been classified as Group A (known human) carcinogens. Several other organic compounds have been classified as Group B2 (probable human) carcinogens.

3.2.4 Preliminary Risk Characterization

Groundwater

As discussed in Section 3.1, several perimeter locations surrounding the site have revealed low-level VOC contamination in monitoring wells. However, monitoring wells and residential wells located at greater distances from the site have revealed either no contamination or patterns that are sporadic and/or difficult to correlate with the groundwater data closer to the site. Off-site residents currently rely upon residential wells for domestic water supply needs, including drinking, cooking, showering, and bathing. The trace levels of VOCs detected in monitoring wells near the site or on-site suggest that groundwater contamination at greater distances from the site would be less significant; however, additional monitoring well installation and further sampling of residential wells using low detection limit methodologies is necessary to better characterize the extent of off-site groundwater contamination.

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TABLE 3-7
COMPARISON OF RANGE OF CONCENTRATION OF CONTAMINANTS FOUND IN GROUNDWATER WITH REGULATORY REQUIREMENTS AND DOSE-RESPONSE-PARAMETER
KEYSTONE SANITATION LANDFILL SITE

Chemical	Range of Concentration (μg/l)	Safe Drinking Water Act[1]		Reference Dose[1] (mg/kg/day)		Health Advisories[1] (μg/l)				Cancer Slope Factor[1] (mg/kg/day)⁻¹		EPA Weight of Evidence[1][2][3]
		MCLG (μg/l)	MCL (μg/l)	Oral	Inhalation	Longer Term/Child	Longer-Term/Adult	DWEL	Lifetime /Adult	Oral	Inhalation	
vinyl chloride	0.002J - 107	ZERO	2			0.01	0.05					A
chloroethane	3J - 18				2.86							
methylene chloride		ZERO	5	0.06				2		7.5E-3	1.6E-3	B2
1,1-dichloroethene	1 - 206	7	7	0.009		1	4	0.4	0.007	6E-01		C
1,1-dichloroethane	1 - 124											
1,2-dichloroethene (total)[5]	1 - 223	70	70	0.01		2	6	0.4	0.07			D
1,1,1-trichloroethane	0.03J - 1,300	200	200	0.035		40	100	1	0.2			D
trichloroethene	0.2 -120	ZERO	5					0.3				B2
tetrachloroethene	0.02J - 250	ZERO	5	0.01		1	5	0.5				
dichlorodifluoromethane	48			0.2		9	30	5	1			D
benzene	2 - 14	ZERO	5							2.9E-2	2.9E-2	A
carbon disulfide	0.1J - 7			0.1								
cetone	7J - 130			0.1								D
-methyl-2-pentanone												
-hexanone												
-chlorophenol				0.005		0.05	0.2	0.2	0.04			D
enzoic acid	3J - 4J			4								D
methyl phthalate	0.4J											D
ethyl phthalate	0.3J - 2J			0.8				30	5			D
di-n-butyl phthalate	0.5J - 29			0.1				4				D

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TABLE 3-7
COMPARISON OF RANGE OF CONCENTRATION
OF CONTAMINANTS FOUND IN GROUNDWATER
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 3

Chemical	Range of Concentration (µg/l)	Safe Drinking Water Act[1]		Reference Dose[1] (mg/kg/day)		Health Advisories[1] (µg/l)				Cancer Slope Factor[1] (mg/kg/day)-1		EPA Weight of Evidence
		MCLG (µg/l)	MCL (µg/l)	Oral	Inhalation	Longer Term/Child	Longer-Term/Adult	DWEL	Lifetime /Adult	Oral	Inhalation	
bis(2-ethylhexyl) phthalate	1J - 7J	ZERO	6	0.02				0.7		1.4E-2		B2[7]
butylbenzyl phthalate		ZERO	100	0.2				6				C
di-n-octyl phthalate												
fluoranthene				0.04								D
pyrene				0.03								D
phenanthrene												
anthracene				0.3								D
chrysene	4J	ZERO	02									B2
benzo(b)fluoranthene		ZERO	02									B2
benzo(k)fluoranthene		ZERO	02									B2
benzo(a)pyrene		ZERO	02							7.3E+0		B2[7]
indeno(1,2,3-c,d)pyrene	7J	ZERO	04									B2
dibenz(a,h)anthracene	5J	ZERO	03									B2
benzo(g,h,i)perylene	8J											D
dieldrin				0.00005		0.0005	0.002	0.002		1.6E+1	1.6E+1	B2
aldrin	0.021J - 0.16			0.00003		0.0003	0.0003	0.001		1.7E+1	1.7E+1	B2
4,4'-DDT	0.04J - 0.35			0.0005						3.4E-1	3.4E-1	B2
antimony	60	6	6	0.0004		0.01	0.015	0.01	0.003			
barium	5.2J - 5,310	2000	2000	0.07				2	2			D

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TABLE 3-7
COMPARISON OF RANGE OF CONCENTRATION OF CONTAMINANTS FOUND IN GROUNDWATER KEYSTONE SANITATION LANDFILL SITE
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Chemical	Range of Concentration (µg/l)	Safe Drinking Water Act[1]		Reference Dose[2] (mg/kg/day)		Health Advisories[1] (µg/l)				Cancer Slope Factor[2],[3] (mg/kg/day)$^{-1}$		EPA Weight of Evidence[1,2,3]
		MCLG (µg/l)	MCL (µg/l)	Oral	Inhalation	Longer Term/Child	Longer-Term/Adult	DWEL	Lifetime /Adult	Oral	Inhalation	
beryllium	1.2	4	4	0.005		4	20	0.2		4.3E-0		B2
cadmium	0.6 - 26	5	5	0.0005		0.005	0.02	0.02	0.005			B1
chromium	3 - 658L	100	100	0.005[6]		0.2	0.8	0.2	0.1			A[6]/D
cobalt	[4.9] - 246											
copper	8.8J - 4,820	1,300	TT[4] A=1,300									D
lead	[2.0] - 126	ZERO	TT[4] A=15									B2
manganese	1 - 170,000			0.005	5E-5							D
mercury	[0.1] - 2.5	2	2	0.0003			0.002	0.01	0.002			D
nickel	[4.5] - 1,070L	100	100	0.02		0.5	1.7	0.6	0.1			D
selenium	[1.0]L - [4.7]	50	50	0.005								D
silver				0.005		0.2	0.2	0.2	0.1			D
vanadium	24			0.007								D
zinc	3.7J - 3,300			0.3		3	12	11	2	5		D

(1) U.S. EPA, Office of Water, Drinking Water Standards and Health Advisories, U.S. EPA, May 1994.
(2) U.S. EPA, Integration Risk Information System (IRIS), June 1994.
(3) U.S. EPA, May 1994. (Health Effects Assessment Summary Tables.)
(4) Action level for water treatment technology (TT) for public water supply systems.
(5) Where applicable, listed criteria are the more strict of total, cis-, and trans- criteria.
(6) Chromium value is for hexavalent form; other values are for total chromium.
(7) Under review.
Blank indicates toxicity criterion or standard is not available.

A Known human carcinogen
B1/B2 Probable human carcinogen
C Possible human carcinogen
D Not classified

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Table 3-8 presents the potential lifetime cancer risk and/or hazard quotient (an indicator of noncarcinogenic risk) for the chemicals detected in the off-site groundwater assuming that the groundwater (either off-site monitoring wells or residential wells) containing the maximum detected concentrations of contaminants (using only validated analytical data from OU-1 RI/FS) is utilized as a domestic water supply source. Table 3-8 does not necessarily represent the actual groundwater concentrations for off-site residential wells; however, analytical data from monitoring wells were utilized to estimate potential future exposure to residential wells. In the following table, exposure dose and risk were calculated assuming that a 70-kilogram individual is exposed as the result of the <u>domestic</u> use of the groundwater (ingestion, inhalation during showering, and dermal contact routes of exposure were evaluated.)

As an indication of the potential for future risk associated with groundwater contamination (based on either monitoring or residential well data), risks were estimated assuming the domestic use of the water containing the maximum identified contaminant concentrations (a worst-case scenario). The estimated excess lifetime cancer risks for several volatile organic chemicals approach or exceed the 1 X 10^{-6} level. For reference, EPA considers the 10^{-4} to 10^{-6} range as a threshold for unacceptable risk. In addition, carcinogenic risks approach or exceed the 1 X 10^{-4} level for two polyaromatic hydrocarbons (PAHs). This issue will be explored more thoroughly in the OU-2 RI, since only two instances of PAH detection in groundwater occurred during the OU-1 RI, which tends to question whether PAH contamination is a real or general problem at off-site locations. The hazard quotient is defined as the ratio of the estimated exposure dose to the RfD, a dose at which or below which noncarcinogenic health effects are not anticipated. The hazard quotient exceeds unity, indicating a potential for adverse non-carcinogenic health effects, only for manganese and is within an order of magnitude of unity for four metals if either an adult or small child is evaluated as the receptor of concern. However, it should be noted that the sampling and analytical approach for the OU-2 RI will include procedures to ensure that dissolved metals are appropriately measured, since data may be substantially biased if suspended solids are included in the groundwater analysis.

Surface/Subsurface Soils and Wastes

Contamination of off-site surface/subsurface soils is not fully characterized, particularly in the area of the spray treatment system. However, the assessment of risks to off-site receptors from this exposure pathway did not represent a significant contribution to the overall risks from the site identified during the OU-1 RI (Table 7-7, page 7-60 indicates that surface soil represented carcinogenic risks on the order of 10^{-8} and a hazard index on the order of 10^{-4}, which is between 0.1 percent and 0.01 percent of the overall risks posed by the site). Thus, although this pathway will be quantitatively evaluated during the OU-2 RI, a quantitative risk assessment of soil contaminant concentrations and associated risks is not presented in this preliminary risk assessment.

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TABLE 3-8
RISK ASSESSMENT SPREADSHEET - EXPOSURES THROUGH HOUSEHOLD USE OF GROUNDWATER
EXPOSURE SCENARIO: MAXIMUM OFF-SITE GROUNDWATER CONCENTRATION FOR ALL CHEMICALS (ONLY OU-1 RI/FS VALIDATED DATA USED)
KEYSTONE SANITATION LANDFILL SITE

CHEMICAL	CONCENTRATION (µg/l)	HAZARD INDEX INGESTION	HAZARD INDEX DERMAL	HAZARD INDEX INHALATION	CANCER RISK INGESTION	CANCER RISK DERMAL	CANCER RISK INHALATION
vinyl chloride	4				8.9e-05	1.6e-06	7.6e-06
chloroethane	10	6.8e-04		5.1e-05			
1,1-dichloroethene	5	1.5e-02	5.9e-04		3.5e-05	1.4e-06	4.9e-06
1,1-dichloroethane	26	7.1e-03	1.5e-04	2.2e-03			
1,2-dichloroethene	28	7.7e-02	1.9e-03				
1,1,1-trichloroethane	20	1.6e-02	1.3e-03	7.8e-04			
trichloroethene	18	8.2e-02	3.2e-03		2.3e-06	9.0e-08	5.1e-07
tetrachloroethene	27	7.4e-02	8.6e-03		1.6e-05	1.9e-06	2.3e-07
dichlorodifluoromethane	16	2.2e-03					
benzene							
carbon disulfide	8	2.2e-03	2.6e-04	3.8e-02			
acetone							
benzoic acid	4	2.7e-05	4.9e-07				
dimethyl phthalate	0.4	1.1e-06	8.5e-09				
diethyl phthalate	0.4	1.4e-05	3.2e-07				
di-n-butyl phthalate	29	7.9e-03	7.1e-04				
bis(2-ethylhexyl) phthalate	7	9.6e-03	1.5e-03		1.2e-06	1.8e-07	
chrysene							
indeno(1,2,3-cd)pyrene	7				6.0e-05		5.0e-09
dibenzo(a,h)anthracene	5				4.3e-04		3.8e-08
benzo(g,h,i)perylene*	8						
aldrin	0.16	1.5e-01	1.1e-03		3.2e-05	2.5e-07	6.0e-07

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TABLE 3-8
RISK ASSESSMENT SPREADSHEET - EXPOSURES THROUGH HOUSEHOLD USE OF GROUNDWATER
EXPOSURE SCENARIO: MAXIMUM OFF-SITE GROUNDWATER CONCENTRATION FOR ALL CHEMICALS (ONLY OU-1 RI/FS VALIDATED DATA USED)
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 2

CHEMICAL	CONCENTRATION (µg/l)	HAZARD INDEX INGESTION	HAZARD INDEX DERMAL	HAZARD INDEX INHALATION	CANCER RISK INGESTION	CANCER RISK DERMAL	CANCER RISK INHALATION
4,4'-DDT	0.35	1.9e-02	2.5e-02		1.4e-06	1.8e-06	2.6e-08
antimony	59	4.0e+00	2.0e-01				
barium	189	7.4e-02	4.5e-03				
beryllium	1.2	6.6e-03	1.6e-03		6.1e-05	1.5e-05	
cadmium	2	1.1e-01	5.3e-03				
chromium[1]	44.2	2.4e-01	5.9e-02				
cobalt	36.6	5.6e-03					
copper	514	3.8e-01	1.6e-03				
lead	26						
manganese	818	4.5e+00	3.6e-01				
mercury	2.5	2.3e-01	7.9e-03				
nickel	64.2	8.8e-02	1.4e-04				
selenium	4.7	2.6e-02	7.8e-05				
vanadium	24.1	9.4e-02	2.3e-02				
zinc	365	3.3e-02	1.9e-04				

Chromium criteria for hexavalent form are used as worst case.

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Surface Water/Sediments/Biota

The OU-1 RI report indicated that off-site contamination in surface waters and sediments did not represent a significant contribution to the overall risks from the site. Additional sampling and analysis will be performed to more thoroughly characterize this exposure pathway. In addition, potential bio-uptake of contaminants in crops and livestock will be investigated and, if contaminants are detected in farmlands, potential risks to consumers will be estimated.

Air

Receptors may be exposed to off-site contaminants via the inhalation of air. Contaminants may enter the air as vapors that are volatilized from contaminated soils or adsorbed to soil particulates that are transported by wind erosion. Exposure could potentially occur under baseline conditions, during agricultural operations (soil tilling), and/or as a result of other soil disturbances. The OU-1 RI report estimated that the lifetime excess cancer risks from inhalation of carcinogenic components of surface soil/wastes yielded a total excess risk on the order of 10^{-6}, which was not significant relative to health risks posed by groundwater at the site. Off-site risks posed by the air pathway will be evaluated during the OU-2 RI/FS and will include a soil gas survey and methane survey to determine the potential for volatilization of chemicals from areas near the site boundaries. In addition, the potential influence of landfill gas generation (i.e., methane) on VOC emissions will be measured.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

A complete survey of federal, state, and local regulations and requirements will be conducted to identify the ARARs for the Keystone Sanitation Landfill Site.

One of the primary concerns in the development of remedial action alternatives for sites governed by CERCLA, as modified by the Superfund Amendments and Reauthorization Act (SARA), is the degree of public health or environmental protection afforded by each alternative. EPA policy states that, in the process of developing and selecting remedial alternatives, primary consideration should be given to remedial action alternatives that attain or exceed ARARs, as defined by SARA in the National Contingency Plan. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent federal and state environmental requirements. SARA defines an ARAR as

- Any standard, requirement, criterion, or limitation under federal environmental law

- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility siting law that is more stringent than the associated federal standard, requirement, criterion or limitation.

Applicable requirements are federal public health and environmental requirements that would be legally applicable to a remedial action if that action was not undertaken pursuant to CERCLA. For example, if hazardous waste activities were undertaken pursuant to an approved permit, applicable regulations would be available to legally define the required remedial action for site closure. Relevant and appropriate requirements are federal public health and environmental requirements that apply to circumstances sufficiently similar to those encountered at CERCLA sites, where their application would be appropriate although not legally required. In addition, SARA now requires that state ARARs be considered during the assembly of remedial alternatives if they are more stringent than federal requirements. EPA has also indicated that "other" criteria, advisories, and guidelines must also be considered in devising remedial alternatives. Examples of such criteria to be considered (TBCs) are EPA Drinking Water Health Advisories Cancer Slope Factors, and Reference Doses.

Section 121 of SARA requires that the remedy for a CERCLA site must attain all ARARs unless one of the following conditions is satisfied:

- The remedial action is an interim measure where the final remedy will attain the ARAR upon completion.
- Compliance will result in greater risk to human health and the environment than other options.
- Compliance is technically impractible.
- An alternative remedial action will attain the equivalent of the ARAR.
- For state requirements, the state has not consistently applied the requirement in similar circumstances.
- Compliance with the ARAR will not provide a balance between protecting public health, welfare and the environment at the facility with the availability of Fund money for response at other facilities (Fund-balancing).

In addition to governing response actions at a site, ARARs may also dictate other aspects of the RI/FS. For example, standard analytical methods may be inadequate to indicate compliance or exceedance of the ARAR. Therefore, it is often necessary to consider ARARs during the specification of chemical analytical methods. In light of such concerns, ARARs will be considered at four points during the RI/FS process: project planning (Task 1); risk assessment (Task 6); remedial alternatives screening (Task 9), and remedial alternatives evaluation (Task 10).

ARARS fall into three general categories based on the manner in which they are applied at a site:

- Contaminant Specific - These ARARs may govern the extent of site cleanup. Such ARARs may be actual concentration-based clean-up levels or they may provide the basis for calculating such levels. The Safe Drinking Water Act is a common contaminant-specific ARAR for groundwater.

- Location Specific - These ARARs are considered in view of natural or man-made site features. Examples of natural site features include wetlands, scenic rivers, or floodplains. Man-made features could include the presence of historic districts, for example. ARARs based on aquifer designations are also location-specific ARARs.

- Action Specific - These ARARs pertain to the implementation of a given remedy. Examples of action-specific ARARs include monitoring requirements, effluent discharge limitations, hazardous waste manifesting requirements, and occupational health and safety requirements.

Tables 3-9, 3-10, and 3-11 present a summary of preliminary federal and state ARARs for the Keystone Sanitation Site. The ARARs are presented on the category in which they fall. The rationale for the inclusion of each ARAR is provided in the tables. The ARARs identified in the tables will be refined and revised as necessary as the RI/FS proceeds.

3.4 PRELIMINARY SCOPING OF REMEDIAL TECHNOLOGIES

The result of the Keystone Sanitation OU-1 RI and risk assessment, which evaluated on-site and off-site contamination, determined that a remedial response action was required. The remedy selected for the Keystone Sanitation Landfill is a program that includes extraction and treatment of groundwater, installation of an impermeable cap, excavation and relocation of contaminated soils from the spray irrigation area, installation of a methane gas extraction system, placement of restrictions on future property use, water treatment for on-site residents, installation of a perimeter fence, and monitoring of groundwater. EPA determined that the selected remedy represents the maximum extent to which permanent treatment technologies can be utilized in a cost-effective manner for the Keystone Sanitation Site.

TABLE 3-9
PRELIMINARY FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
KEYSTONE SANITATION LANDFILL SITE

CONTAMINANT-SPECIFIC REQUIREMENT	RATIONALE
Safe Drinking Water (42 USC 300)	
• Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) (40 CFR, Part 141)	Remedial actions may include groundwater clean-up to MCLs and MCLGs, SARA Section 121(d)(2)(A)(ii).
• Underground Injection Control Regulations (40 CFR, Parts 144-147)	May be applicable to on-site groundwater recirculation systems.
Clean Water Act (33 USC 1251-1376)	
• Federal ambient water quality criteria (AWQC)(40 CFR 131)	Remedial actions may result in surface water discharges that could impact aquatic life.
Air Emissions from Non-Attainment Areas (OSWER Directive 9355.0-28)	Remedial alternatives may result in air emissions.
Clean Air Act (42 USC 7401)	
• National Ambient Air Quality Standards (NAAQS) for six criteria pollutants (40 CFR Part 50)	Remedial alternatives may include groundwater volatilization technologies.
• National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CRF 61.60-61.71)	Remedial alternatives may result in hazardous chemical emissions.
Reference Doses (RFDs), EPA Office of Research and Development	Considered in the human health assessment.
Cancer Slope Factors, EPA Environmental Criteria and Assessment Office; EPA Carcinogen Assessment Group	Considered in the human health assessment.
Health Advisories, EPA Office of Drinking Water	Considered in the human health assessment.
Health Effects Assessments, EPA Environmental Criteria and Assessment Office	Considered in the human health assessment.
Off-Site Disposal Requirements (Land Ban) (40 CFR 268.1-268.5)	Remedial actions may require off-site disposal of wastes.
Federal Water Quality Standards (51 FR 43665)	Remedial actions may affect surface waters

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LOCATION-SPECIFIC REQUIREMENT	RATIONALE
Implementation of National Environmental Policy Act (40 CFR Part 6, Appendix A)	Wetland and floodplain resources may be affected by remedial action.
Endangered Species Act of 1973 (16 CFR 1531)	Considered in the environmental assessment.
Fish and Wildlife Coordination Act of 1980 (16 USC 661)	Remedial alternatives may affect fish and wildlife habitat.
Fish and Wildlife Conservation Act of 1980 (16 USC 2901)	Remedial alternatives may affect fish and wildlife habitat.
Fish and Wildlife Improvement Act of 1978 (16 USC 742A)	Remedial alternatives may affect fish and wildlife habitat.
Flood Disaster Protection Act of 1973 and National Flood Insurance Act of 1986	Floodplain resources may be affected by remedial action.
Groundwater Protection Strategy	Remedial alternatives may be determined by class designation.

ACTION-SPECIFIC REQUIREMENTS	RATIONALE
Hazardous Waste Requirements (RCRA Subtitle C, 40 CFR, Part 264)	Standards applicable to treating, storing, and disposing hazardous wastes.
OSHA Requirements (29 CFR, Parts 1910, 1926, and 1904)	Required for workers engaged in on-site remedial activities.
Threshold Limit Values, American Conference of Governmental Industrial Hygienists	May be applicable to air concentrations during remedial activities.
DOT Rules for Hazard Materials Transport (40 CRF, Parts 107, 171.1-500)	Remedial alternatives may include off-site treatment and disposal.
Clean Waters Act (33 USC 1251-1376) • NPDES Permits (40 CFR 122-124)	Regulates point source discharge.
Regulation of Activities Affecting Water of the U.S. (33 CFR, Parts, 320-329)	Corps of Engineers regulations apply to both wetlands and navigable waters (Section 10, Waters).
National Environmental Policy Act of 1969	Requires consideration of environmental affects on federal actions.

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TABLE 3-10
PRELIMINARY PENNSYLVANIA APPLICABLE ON RELEVANT AND APPROPRIATE REQUIREMENTS
KEYSTONE SANITATION LANDFILL SITE

CONTAMINANT-SPECIFIC REQUIREMENT	RATIONALE
Pennsylvania Water Quality Standards (25 PA Code, Chapter 93)	Remedial actions may include discharge to surface waters.
Pennsylvania Air Pollution Regulations (25 PA Code, Chapter 121-143)	Remedial actions may include technologies with atmospheric emissions.
Pennsylvania Safe Drinking Water Regulations (25 PA Code, Chapter 109)	State MCLs and treatment techniques.

LOCATION-SPECIFIC REQUIREMENT	RATIONALE
Rare and Endangered Species Regulations (58 PA Code)	Considered in the public health and environmental assessment.
Dam Safety and Waterway Management (25 PA Code, Chapter 105, Section 451, Wetlands)	Wetland resources may be affected by remedial action.

ACTION-SPECIFIC REQUIREMENTS	RATIONALE
Pennsylvania Hazardous Waste Management (25 PA Code, Chapter 260, et seq.)	Standards for treating, storing, and disposing of hazardous wastes.
Pennsylvania Solid Waste Disposal Regulations (25 PA Code, Chapter 75)	Standards for treating, storing, and disposing of solid wastes.
Pennsylvania Pollutant Discharge Elimination System (NPDES) Rules (25 PA Code, Chapter 92)	Remedial actions may include discharge to surface waters.
Pennsylvania Wastewater Treatment Requirements (25 PA Code, Chapter 95)	Remedial actions may include discharge to surface waters.
Pennsylvania Industrial Waste Treatment (25 PA Code, Chapter 97)	Remedial actions may include discharge to surface waters.
Pennsylvania Special Water Pollution Regulations (25 PA Code, Chapter 101)	Applicable for permitted solid waste disposal facilities.
Pennsylvania Storm Water Management Act of October 4, 1978, Acto No. 167	Remedial actions may require stormwater management systems.
Pennsylvania Erosion Control Regulations (25 PA Code, Chapter 102)	Soil disturbance during proposed remedial actions may require erosion and sedimentation control measures.
Pennsylvania Hazardous Substances Transporation Regulations PA Code Title 13 (Flammable Liquids and Flammable Solids) and Title 15 (Oxidizing Materials, Poisons, and Corrosive Liquids).	Applicable to wastes shipped off-site for analysis, treatment, or disposal.
Pennsylvania Hazardous Waste Management (25 PA Code, Chapter 264.90-264.100)	Pennsylvania Clean-up Standards
Pennsylvania Water Well Driller License Act (25 PA Code, Chapter 107)	Required for drillers for monitoring well installation.

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TABLE 3-11
PRELIMINARY MARYLAND APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS KEYSTONE SANITATION LANDFILL SITE

CONTAMINANT-SPECIFIC REQUIREMENT	RATIONALE
Maryland Department of the Environment (Title 26, Part 1, Subtitle 8, Water Pollution)	Remedial actions may include discharge to surface waters.
Maryland Department of the Environment (Title 26, Part 2, Subtitle 11, Air Quality)	Remedial actions may include technologies with atmosphere emissions.
Maryland Department of Environment (Title 26, Part 1, Subtitle 04, Regulation of Water Supply, Sewage Disposal, and Solid Waste)	Remedial alternatives may result in air emissions.

ACTION-SPECIFIC REQUIREMENT	RATIONALE
Non-Game and Endangered Species Conservation Act	Considered in the Public Health and Environmental Assessment

ACTION-SPECIFIC REQUIREMENT	RATIONALE
Maryland Department of the Environment (Title 26, Part 1, Subtitle 13, Disposal of Controlled Hazardous Substances)	Standards for treating, storing, and disposing of hazardous wastes.
Maryland Department of the Environment (Title 26, Part 1, Subtitle 4, Regulation of Water Supply, Sewage Disposal, and Solid Waste)	Standards for treating, storing, and disposing of solid waste.
Maryland Department of the Environment (Title 26, Part 1, Subtitle 9, Water Management)	Soil disturbances during remedial actions may require erosion and sedimentation control measures.

The main focus of the OU-2 RI is to provide the necessary data from the area surrounding the landfill to complete a comprehensive risk assessment and ecological assessment, thereby providing an accurate determination of unacceptable risks to individuals and wildlife residing in the vicinity of the Keystone Sanitation Landfill. Information obtained during the OU-2 RI will provide input for the development, screening, and detailed evaluation of viable and appropriate remedial alternatives during the OU-2 feasibility study. Table 3-12 provides a preliminary summary of the technologies that could conceivably need to be evaluated. Data obtained during the OU-2 RI will be provided to the OU-1 remedial design/remedial action (RD/RA) project team for review and evaluation during OU-1 remedial activities.

3.5 DATA LIMITATIONS AND REQUIREMENTS

The previous portions of this section of the work plan discuss site-related contamination, human health and environmental risks, ARARS, and potential remedial alternatives. Based on existing information, including results of the OU-1 RI/FS, several data requirements have been identified to address remaining data gaps. Data needed to supplement the existing data base, evaluate risks, and develop remedial alternatives for groundwater, surface water and sediments, and soils are presented in Table 3-13.

The specific objectives of the RI/FS are to

- Determine the lateral and vertical extent of off-site groundwater contamination attributable to the landfill, particularly with respect to downgradient wells and surface water discharge.

- Assess the extent of surface water/sediment contamination in the vicinity of the site.

- Determine the extent of soil contamination west, south, and east-southeast of the landfill.

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TABLE 3-12
PRELIMINARY TECHNOLOGY SCREENING
KEYSTONE SANITATION LANDFILL SITE

ENVIRONMENTAL MEDIUM	RESPONSE ACTION	TECHNOLOGY	TECHNICAL CONSIDERATIONS	INSTITUTIONAL CONSIDERATIONS	PUBLIC HEALTH AND ENVIRONMENTAL CONSIDERATIONS
Groundwater	No Action	None	None	Potentially unacceptable.	Does not reduce contaminant concentration in the groundwater.
	Institutional Actions	Access restriction Alternate water supply Point of use treatment	Deed restrictions on installing new wells.	Property deeds would require restrictions.	Does not prevent migration but does provide warning to public health.
	Alternate water supply	Municipal well system	Distance from site. Capacity of the system.	Costs to residents.	Prevents ingestion of contaminated water.
	Point of use system	Individual home treatment units	Complexity of system depends on contaminants to be removed.	Requires maintenance.	Prevents ingestion of water with contaminants above MCLs or RFDs.
	Monitoring	Sampling	Periodic long-term groundwater monitoring.		Does not prevent migration but does provide warning to public health.
	Collection/Treatment Actions	Capping	Reduces contaminant leaching from soils to groundwater.		Protects health but does not actively remediate groundwater.
		Activated carbon	Proven technology for organics removal.	Meets contaminant removal requirements, disposal or regeneration of carbon.	Organic contaminants removed; spent carbon must be handled, metals not treated.
		Air stripping	Proven effective for volatile organics	Air emission controls and permit required.	Does not treat metals, PCBs, or high-molecular-weight organics. Effective for volatile organics.
		Coagulation/Filtration Sedimentation	Proven technology for metals and solids removal; treatability studies necessary.	Disposal of waste sludge.	Residuals waste sludge disposal problem; volatile organics not treated; therefore, potentially not useful for this site.
		Ion Exchange	Effective for metals; fouling problems; treatability studies may be necessary.	Disposal of residual brines produced during resin regeneration operations.	Metals removed; however, the organic residuals must be handled.
Surface Water/Sediments	Removal	Excavation of contaminated sediments	Excavation is difficult; dewatering of excavated sediment; water treatment and handling.	May affect nearby wetlands.	Excavation may mobilize contaminants.
	Excavation, Treatment, and/or Disposal/Fill	Thermal stripping	Requires excavation of soils and some presorting; requires pilot testing to confirm applicability; proven for volatile organics; requires soil and groundwater monitoring; does not address metals.	Residues may be disposed off-site or returned to site with approval; requires air controls and permit.	Overall effectiveness for all wastes is unknown; excavation activities may increase migration and exposure.

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TABLE 3-12
PRELIMINARY TECHNOLOGY SCREENING
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 2

ENVIRONMENTAL MEDIUM	RESPONSE ACTION	TECHNOLOGY	TECHNICAL CONSIDERATIONS	INSTITUTIONAL CONSIDERATIONS	PUBLIC HEALTH AND ENVIRONMENTAL CONSIDERATIONS
Surface Water/ Sediments (continued)	Excavation, Treatment, and/or Disposal/Fill	Incineration	Proven effective for volatile organics, phthalates, and PCBs; requires excavation, presorting, and handling; high power requirements; large ash residue; high capital costs.	Listed ash disposal or returned to site; requires air controls and permit.	Air and water emissions concerns; excavation activities may increase migration and exposure.
		Solidification	Emerging technology for treatment of organic wastes; developed for inorganic wastes; some volumetric increase will occur.	Leaching characteristics must be investigated to delist materials.	Physical hazards during excavation; potential exposure to wastes/contaminated soils (direct contact); potential emission of volatiles and fugitive dust; may impact groundwater/surface water flow conditions.
Soils/Sediments	Excavation and Off-site Disposal	Secure landfill	Sediment volume requiring excavation is undefined.	Must be disposed at an EPA-approved facility; transport must comply with DOT regulations.	Confirmation of sufficient removal; excavation activities may increase migration and exposure.
	In-situ Treatment	Soil Vapor Extraction	Can be effective for volatiles; suitability depends on soil/sediment characteristic.	Air emissions must be treated.	Air emissions concerns, addresses volatiles contamination only.
	Containment	Capping	Prevent contact with contaminated soils.	Future land use restricted.	Does not actively remediate soils; potential contaminant source remains in place.

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TABLE 3-13
SUMMARY OF RI/FS SCOPING PROCESS AND DATA REQUIREMENTS
KEYSTONE SANITATION LANDFILL SITE

Identified Contamination/Suspected Contamination	Preliminary Risk Evaluation	Preliminary ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Required to Estimate Risks and Evaluate Potential Remedial Alternatives	
							Risk	Geology/ Engineering
MEDIUM: GROUNDWATER								
The following chemicals are considered contaminants of concern for the Keystone (OU-2) RI/FS: Volatiles semivolatiles pesticides metals (See Tables 3-6 and 3-7)	Contaminated groundwater poses threat to users and may discharge to surface waters Potential human exposure pathways include • Ingestion • Inhalation • Dermal absorption	MCLs PADER Ch. 75 PADER Ch. 109 EPA Health Advisors MDE Title 26, Part 1	Remediate groundwater/manage contaminant migration to • Reduce exposure potential • Reduce contaminant concentration in the groundwater to the extent that receptor exposure point concentrations are below clean-up criteria	AWQC MCLs PA Water Quality Standards MD Water Quality Standards	No action Collection/ treatment Institutional actions Alternative residential water supply Point of use treatment No actions with monitoring Access restriction	Monitoring/ sampling Capping Activated carbon Air stripping Statutory groundwater use limitation Municipal water system In-line filter system	• Extent of groundwater contamination • Identification of source contribution • Background concentrations • User inventory	• Plume dimension and volume • Physical/ hydrogeological characteristics of the aquifer • Groundwater treatability data

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TABLE 3-13
SUMMARY OF RI/FS SCOPING PROCESS AND DATA REQUIREMENTS
KEYSTONE SANITATION LANDFILL

Identified Contamination/Suspected Contamination	Preliminary Risk Evaluation	Preliminary ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Required to Estimate Risks and Evaluate Potential Remedial Alternatives	
							Risk	Geology/ Engineering
MEDIA: SURFACE WATER AND SEDIMENT								
The following chemicals are considered contaminants of concern for the Keystone (OU-2) RI/FS Volatiles, bis(2-ethylhexyl)phthalate, metals (See Tables 3-6 and 3-7)	Contaminants that reach surface water/ sediments via groundwater discharge or surface water runoff/drainage may threaten downstream fishing, recreation, drinking water uses, and aquatic organisms.	MCLs RCRA PADER Ch 75 MDE Title 26, Part 1, Subtitle 8	• Control migration of contaminants to surface water/sediments • Assure that site-related contaminant concentrations in surface waters/ sediments do not exceed health-based standards/criteria/risk levels established for human and aquatic life	AWQC MCLs RCRA PA Water Quality Standards MDE Water Quality Standards	Excavation, treatment, disposal of sediments Excavation and off-site disposal of sediments	Excavation of contaminated sediments Thermal stripping Incineration/ solidification/ landfilling	• Surface water concentrations (background and downstream) • Sediment concentrations (background and downstream) • Extent of contamination • Biota concentrations (Species identification/ diversity)	Contaminated sediments volume, density treatability • Stream flow

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TABLE 3-13
SUMMARY OF RI/FS SCOPING PROCESS AND DATA REQUIREMENTS
KEYSTONE SANITATION LANDFILL

Identified Contamination/Suspected Contamination	Preliminary Risk Evaluation	Preliminary ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Required to Estimate Risks and Evaluate Potential Remedial Alternatives	
							Risk	Geology/ Engineering
MEDIA: OFF-SITE SURFACE/SUBSURFACE SOILS				**POTENTIAL PATHS: DIRECT CONTACT, AIR, GROUNDWATER, SURFACE WATER**				
The following chemicals are considered contaminants of concern for the Keystone (OU-2) RI/FS: Volatiles, semivolatiles, pesticides, metals See Tables 3-6 and 3-7	Direct contact threat. Possibility of groundwater, surface water, and air contamination	PADER Ch. 75 MDE Title 26	Mitigate threats of direct contact and migration of contaminations to groundwater, surface water, sediments, and air. - Source control - Reduce exposure potential - Reduce contaminant concentration	LDRs Groundwater contamination TSCA	Containment Excavation and disposal Excavation and treatment/ disposal In-situ treatment	Thermal treatment Biological treatment Landfilling Vacuum extraction	• Surface/sub-surface soil contaminant concentrations • Contaminant leachability • Prevailing wind direction • Extent of contamination • Background concentrations	• Surface/sub-surface soil volume, density, and treatability • "Hazardous waste" determination

- Investigate methane gas migration from the site.

- Assess potential risks to human health and the environment in the vicinity of the site.

- Evaluate potential impacts on ecological receptors in the vicinity of the site.

- Determine appropriate remedial responses for off-site groundwater, surface water and sediments, and soil.

As stated in the previous section, the primary purpose of the OU-2 RI/FS is to define the nature and extent of off-site contamination, assess the unacceptable risks to human health and the environment, and develop and evaluate potential remedial alternatives. As discussed in Section 4.3.4, installation of monitoring wells and a hydrogeologic investigation are planned to better define hydrologic conditions in the study area. Multiple rounds of media sampling are proposed to provide data needed to complete a comprehensive risk assessment and ecological assessment. The risk assessment requires medium-specific data on the nature and extent of contamination to fully evaluate potential risks resulting from the defined exposure scenarios. In order to fully address potential remedial alternatives, specific non-routine analytical services parameters will be requested.

The full assessment of potential remedial alternatives for groundwater requires data on a variety of physical parameters such as total organic carbon (TOC), alkalinity, total dissolved solids (TDS), total suspended solids (TSS), etc. These parameters are used to determine specific design criteria for treatment systems. Evaluation of remedial options for soil will also require collection of toxicity characteristic leachate procedure (TCLP) data (for off-site disposal) and water-based leaching data to determine source control requirements.

3.6 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support Agency decisions during remedial response activities. Dos are determined based upon the end use of the data to be collected. The DQO process is a series of planning steps based upon the scientific method that is designed to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application. The seven steps that are involved can be summarized as stating the problem, identifying the decision, identifying inputs to the decision, defining study boundaries, developing a decision rule, specifying limits on decision errors, and optimizing the design for obtaining data. The outputs from each step of the DQO process serve to clarify the stu objective, define the most appropriate type of data to collect, determine the most appropriate conditions under which to collect the data, and specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the decision. The outputs of the DQO process are then used to develop a scientific and resource-effective sampling design.

3.6.1 Statement of the Problem

The principal problem to be addressed by the OU-2 scope of work is to determine whether any off-site contamination attributable to the site poses unacceptable risk to human health or the environment. Although data from the OU-1 investigation are considered to be of known quality, data gaps exist in several areas. The media to be investigated are groundwater, surface/subsurface soil, and surface water/sediment. Although considerable historical data exist, particularly for the groundwater pathway, further investigation is necessary to develop a more comprehensive understanding of chemical migration away from the site. This will be accomplished by studying hydrogeological characteristics such as hydraulic head and groundwater flow gradients and the locations of fractures and other geophysical features that determine boundaries and preferential directions of flow and by providing chemical analysis results to more thoroughly characterize contaminants present in off-site groundwater. Data collection will need to include analysis of groundwater at new monitoring points and additional sampling of existing wells. In general, it is not possible to resolve analytical data gaps using other historical sampling data for which QA/QC (i.e., validation) information is not available or that, in some cases, suggests inconsistent spatial or temporal contamination patterns. For example, trace-level detections of several volatile compounds were reported in only one out of several topographically related wells and/or during only one isolated sampling event out of as many as 20 samplings of a given well, and there were sporadic instances of well contamination reported for compounds that are commonly found as laboratory contaminants or artifacts. The OU-2 RI/FS will characterize the nature and extent of off-site contamination associated with site-related landfilling activities, provide a comprehensive assessment of the actual and potential human health and environmental risks associated with the site, and develop and screen remedial alternatives.

3.6.1.1 DQO Scoping Team

The project management organization for this investigation is presented in Section 5.1. The members of the DQO scoping team include the EPA RPM, the HNUS project manager, the HNUS multi-disciplinary team comprised of specialists with expertise in hydrogeology, chemistry, toxicology, ecological assessment, statistics, and quality assurance, the technical support team from EPA comprised of specialists in toxicology, chemistry, ecological assessment, and quality assurance, and representatives of Pennsylvania and Maryland state agencies. Representatives of citizens action groups (PACE and CURE) also provided input into the DQO scoping process. The decision makers for the OU-2 RI/FS will include the EPA RPM in conjunction with the EPA task force members and various state and other officials.

3.6.1.2 Conceptual Site Model

Considerable historical data are available to provide a foundation for identifying data gaps and focusing on where the problems of potential contamination may exist. The OU-1 RI/FS and other sampling investigations have been conducted at or near the site, and a summary of these data is presented in Section 3.1 of this work plan. Additional tables and maps depicting the existing residential well and monitoring well information were presented in a December 10, 1993 letter to EPA from HNUS. Of the various contamination pathways studied, the primary potential human health risk identified from the OU-1 RI/FS was the occurrence of low-level VOC groundwater contamination at the site. In the design of a groundwater sampling plan for OU-2, it is important to consider that the site is situated at a topographic and hydrologic high point, which impacts the selection of appropriate background groundwater sampling locations. In addition, the site is located in an area where rather extensive fracturing may affect the direction of groundwater flow in three dimensions, which, coupled with the unusual topography, creates additional problems in the determination of whether any detected off-site contamination is or could be attributable to the site as opposed to any non-site-related sources.

3.6.1.3 Exposure Pathways and Exposure Scenarios

As discussed in Section 3.2, exposure pathways identified under current or future land-use scenarios include household use of contaminated groundwater (ingestion, inhalation, and dermal contact), off-site contact with surficial soils (dermal and incidental ingestion), inhalation of contaminants volatilizing from off-site contaminated soil, contact with surface waters/sediments (dermal and incidental ingestion) from streams potentially contaminated by groundwater discharges to the surface waters or by surface water runoff from the site, and ingestion of contaminated fish taken from streams within the area of influence of the site or contaminated agricultural crops or livestock meat and/or milk raised in areas contaminated by the site. Future land use is assumed to be the same as the current mixed uses (residential, agricultural, and recreational), although expansion of residential zones may occur.

3.6.1.4 Available Resources

Included in the problem scope addressed by the DQO process is a consideration of available resources. Resources for this project include the RI/FS contractor team, HNUS/GF, support contractors such as the TAT team, and various subcontractors. Project schedule and project costs are presented under separate cover, as referenced in Sections 5.3 and 5.4, respectively. Project schedules are being developed to accomplish all work in a reasonable and expedient timeframe; however, due to the multiple decision makers involved in this project, timely communications and interactions on behalf of HNUS, the EPA Keystone task force and project/contract officials, and outside agencies involved in the peer review process could directly influence schedules. In order to minimize the impact of an anticipated lag time required for all parties to review and approve the complete project planning documents required for this RI/FS, EPA arranged for the TAT team to perform the first two rounds of residential well sampling and the first round of surface water/sediment sampling for this RI/FS. In addition, the RPM designated, and HNUS has submitted, a separate work plan for installation of bladder pumps for 29 monitoring wells for which sampling is scheduled for August 1994.

3.6.1.5 Summary of the Contamination Problem

As discussed in Section 3.1, several perimeter locations surrounding the site have revealed low-level VOC contamination in monitoring wells. However, monitoring wells and residential wells located at greater distances from the site have revealed either no contamination or else patterns that are sporadic and/or difficult to correlate with the on-site monitoring well contamination. Off-site residents currently rely upon groundwater for all of their domestic water supply needs. Contamination levels in off-site wells were typically low (near or below conventional quantitation limits) but in some cases included VOCs with carcinogenic potencies that would represent a concern for samples containing concentrations near the quantitation limit (for example, vinyl chloride and 1,1-dichloroethene).

Potential off-site contamination of surface and subsurface soils caused by the groundwater spray treatment system must be investigated, and off-site surface water/sediment pathway contamination must be more thoroughly characterized. In addition, an ecological assessment of potentially contaminated areas is required to determine the potential impacts of any contamination along surface water pathways.

3.6.2 Identification of the Decision

3.6.2.1 Potential Decisions

For the groundwater pathway, it must be determined whether any identified contamination poses an unacceptable risk to human health or the environment. If contamination is present at levels of concern, a determination must be made as to whether contamination is attributable to the site. In addition, it must be determined whether there is a potential for site-related hazardous substances to migrate to additional off-site locations.

For the surface soil pathway, similar decisions must be made as to whether identified contamination poses an unacceptable risk to human health and the environment. If significant potential risks are indicated, the extent of contamination and attribution to the site must be determined.

Surface water and sediment contamination must be investigated to determine if there are unacceptable human health or environmental risks associated with any contamination of these media. In addition, a ecological assessment will determine if adverse effects on terrestrial or aquatic life could potentially exis and the types of potentially affected ecological receptors.

For all potential migration pathways, if significant off-site contamination (as defined by ARARs or risk-basec criteria) is attributable to the site, the evaluation of remedial alternatives will include the selection anc recommendation of appropriate remedial actions to mitigate, prevent, or reduce unacceptable site-relatec risk.

For the ecological assessment, key questions to be answered include the following:

- Have biological communities or populations been measurably impacted by the site?
- Have off-site soils, waters, or sediments exhibited contamination at concentrations potentially toxic to terrestrial or aquatic life?
- Have fish, game animals, crops, or livestock been exposed to contamination at levels that coulc cause adverse effects and/or result in bio-uptake at levels that could present a concern to hum health?
- If the answer to the above questions is yes, are the effects on biological communities and the populations near the site caused by the presence of hazardous substances? Note that the phasec ecological assessment approach described in Section 4.3.6 may not require full-scale investigation if the initial surveys of contamination and biota do not demonstrate the potential for adverse ecological impacts.

3.6.2.2 Potential Actions as a Result of Decisions

The no-action scenario could result from the evaluation of any migration pathway if off-site contaminatior does not exist or does not present current or future risks to human health or the environment.

Recommended remedial actions will be evaluated in the feasibility study for OU-2 if off-site contaminatior exceeds ARARs or presents a significant current or potential risk to human health or the environment arc is attributable to the site. Potential remedial actions are discussed in Sections 4.9, 4.10, and 4.11. As a result of the feasibility study, a ROD could be signed that identifies the legal requirements for reme actions to be implemented.

In the event that significant groundwater contamination is identified that is clearly demonstrated to not be attributed to the site, potential actions would be to recommend further investigation by mechanisms outside of the current project's scope (i.e., through other state, federal, or agency assignments).

In the event that significant groundwater contamination is identified that is inconclusive as far as attribution to the site or if discrepancies from two rounds of sampling do not allow a reliable judgment of whether there is significant contamination at a given groundwater location, an intermediate decision will be made to add additional rounds of sampling for that location to resolve discrepancies and prevent inconclusive findings regarding contaminant attribution to the site. However, characterization of alternate sources of contamination (not related to Keystone Landfill) is not considered to be within the scope of this investigation.

A dynamic decision process will be applied to the surface soil and subsurface soil sampling. Soil gas survey results will be utilized to decide whether contaminants have migrated/are migrating off site and to direct confirmatory sampling at suitable locations to establish the quantitative basis for the nature and extent of contamination along this pathway. The number of rounds or locations of surface water and sediment sampling may also be modified depending upon the outcome of the first two rounds of sampling. The analytical parameters to be included may also be revised.

A dynamic decision process will also be applied to the ecological investigation in that additional phases of work are anticipated to depend upon the findings of the initial rounds of media sampling and initial phases of ecological investigation (see Section 4.3.6).

3.6.3 Identification of Inputs to the Decision

3.6.3.1 Informational Inputs

Table 3-8 in Section 3.5 delineates the site data collection requirements to enable estimation of risks and evaluation of potential remedial alternatives. For the groundwater pathway, informational inputs include hydrogeologic data on aquifer characteristics, plume dimensions and volume, fracture trace information identified from the EPIC survey, piezometric surface data, and hydraulic head data obtained from monitoring well measurements. Background well locations must be identified that are away from the influence of site-related contamination and that are representative of natural groundwater conditions. In addition, analytical data for engineering parameters will provide information required for later scoping of potential remedial alternatives.

For the surface soil pathway, informational inputs include locations for background samples away from the influence of the site (spray irrigation), locations of stained soils or stressed vegetation in the vicinity of the spray irrigation area and along associated drainage pathways, and knowledge of prevailing wind direction and current and potential land uses in this area (types of agricultural activities possible or anticipated suitability of land for potential residential development, etc.).

For the surface water/sediment pathway, informational inputs include data on stream flows, groundwater discharge volumes, and biota inventory and population density. If remedial alternatives evaluation is required in this area, the approximate volume of any contaminated sediment must also be determined along with contaminant leachability, soil density, and other engineering parameters delineated in Section 4.3.5.

For the ecological assessment, field surveys will generate information regarding species, population habitats, and other key characteristics as delineated in Section 4.3.6. More quantitative information (toxicity testing, chemical analysis of biota, etc.) may be required depending upon the outcome of the initial phases of ecological investigation.

In addition to site data collection inputs, general RI/FS informational inputs include up-to-date ARARs and exposure assumptions that could be used to support any preliminary remediation goal (PRG) calculation toxicity information for each contaminant, fate and transport information to be used in assessing exposure and a preliminary definition of the threshold of unacceptable risk. Section 3.3 provides a list of ARARs appropriate for this RI/FS. Standard exposure assumptions will be based upon informational inputs that include default exposure factors from EPA's Exposure Factors Handbook and information on land use and population characteristics. Toxicity information for each contaminant is obtained using the hierarchy of information sources identified in the EPA guidance document, RAGS, Volume I, part A. Some of the extracted toxicity information from several of these sources is presented in Section 3.2. Relevant informational inputs are provided in each of the EPA guidance documents and other publications listed in the Section 6.0 of this work plan.

3.6.3.2 Chemical Analysis Informational Inputs

Sections 4.3.5 and 4.4.2 delineate the specific quantitative (definitive) chemical analytical tests proposed for each environmental medium to be sampled. In addition, specific screening measurements (field instruments, soil gas analysis, and methane survey) are described in Sections 4.3.5 and 4.4.1. Section 4.3.5 also describes the number of multiple sampling rounds proposed to reliably determine the existence of contamination at levels of concern and that may be compared to background measurements.

The off-site groundwater plume and exposure pathway must have specific data gaps resolved by means of additional monitoring well installation and testing and additional residential well sampling. Detection limits for well sampling must be improved over previous studies in order to ensure detection of contamination at levels within the concentration ranges established for protection of human health (e.g., MCLs and the 10^{-4} to 10^{-6} carcinogenic risk level, as discussed in Section 3.2). The extent of off-site soil contamination in the area of the spray treatment system needs to be characterized using soil gas VOC analysis and confirmatory soil analysis. In addition, surface water/sediment pathway contamination must be more thoroughly investigated, and potential mercury contamination needs to be studied using protocols that measure specific mercury species (i.e., methyl mercury). An expanded ecological assessment may require analysis for certain chemical species in order to determine potential impacts on terrestrial and aquatic life. If follow-up phases of ecological investigation are determined to be necessary, further chemical or bio-analytical testing could involve fish, game animals, agricultural crops, and/or livestock.

3.6.4 Definition of Study Boundaries

3.6.4.1 Definition of Spatial Boundaries

All decisions will pertain to off-site contamination areas only (site layout is illustrated in several figures included in this work plan). Areas within the fenced site boundary are not included in this investigation. Off-site groundwater investigation will include sampling of existing and new off-site monitoring wells that, when evaluated together, will help ensure detection of any hazardous substance migration along possible flow directions away from the site. Section 4.3.4 provides rationale for the spatial locations of proposed new monitoring wells so as to characterize groundwater in areas not currently represented by existing monitoring wells and to provide monitoring points that will intercept and allow detection of contaminants in advance of migration to and detection in more distant residential wells. Residential well sampling locations include both pre-determined locations (to be sampled during each round) and dynamic locations (decisions to sample based upon patterns or data needs evident from on-going data collection). The residential well sampling program will characterize current receptor locations that intercept probable directions of groundwater flow away from the site. In addition, after the initial sampling results are evaluated, this sampling plan will be expanded as needed in order to include additional areas of concern necessary to establish an understanding of contaminant migration patterns and to support or refute the attribution of contamination to the site.

Surface and subsurface soil sampling zones are designed to evaluate the potential effects of the spray irrigation system. Sampling boundaries for these areas will be determined during the dynamic soil gas sampling study and will cover not only areas of direct deposition but also subsequent migration to the subsurface or dispersion along surface drainage pathways (see Section 4.3.5).

A methane survey will be conducted around the perimeter of the site and will include two "rings" or sampling points separated by a fixed interval (e.g., 100 feet). This will enable determination of methane releases and whether VOC air pathway emissions are or could be influenced by the presence of methane.

Surface water and sediment locations include springs that receive groundwater discharge or surface water runoff along the watershed pathway from the site. These are described in more detail in Section 4.3.5.

Ecological assessment locations will include studies of the surface water and sediment locations described above and also studies of species that inhabit these areas.

3.6.4.2 Temporal Boundaries

Since the study is intended to determine risk, the groundwater investigation will involve quarterly sampling. Surface water/sediment sampling will also involve multiple rounds to characterize conditions that may change on a seasonal and climatic basis. Sampling will be required during at least one period of heavy precipitation. Similarly, the ecological assessment must account for seasonal variation in surface water flow, temperature, depth, contaminant and nutrient concentrations, and variations in species and population that occur as a result of these and other factors to yield seasonally influenced plant growth, lifecycle, and behavioral patterns.

3.6.4.3 Practical Considerations That May Interfere with the Study

Many of the areas to be sampled are on private property and access will need to be granted before sampling. In addition, logistics for positioning field support stations, subcontractor equipment, and other supplies may be complicated by property access restrictions. Where access to private land is required for sampling, provisions will be required to ensure that agricultural or residential property is not damaged or destroyed by sampling, drilling, or other activities.

An additional practical consideration is the impact of OU-1 remedial activities on the timing of groundwater investigations and testing for OU-2. Communications will be necessary to prevent interference in hydrogeologic testing and also to determine what types of testing data should be utilized to benefit both projects.

3.6.5 Development of Decision Rules

Several types of decisions described in Section 3.8.2 will each require different decision rules. Hydrogeologic investigations described in Section 4.3.4 will establish characteristics of groundwater flow and will be used in conjunction with monitoring well sampling results to determine whether there is significant evidence of off-site monitoring well contamination that is attributable to chemicals of concern that have been shown to be present in groundwater at the site. Hydrogeologic data may indicate boundaries to certain directions of groundwater plume migration and may reveal probable directions of flow. Off-site wells located in very close proximity to one another and screened at similar depths within the same local aquifer flow path will be considered together in evaluating data. Hydrological data will be of key importance to determining which study wells are within the area of influence of contaminant migration and will define the groupings of off-site well results that can be directly compared to a combined data set of background well results and other off-site well results in the evaluation of contaminant attribution. Where necessary, a statistical comparison of well results to background will be performed in the evaluation of certain inorganic contaminants and, in some cases, will include the evaluation of VOC data and other organic contaminant patterns (or the lack thereof). In many cases, contaminant attribution may not be a simple decision for a given off-site well location; analytical and hydrogeological data from more distant wells may need to be considered in conjunction with data obtained from wells closer in towards the site to fully appreciate potential statistical and hydrogeological factors affecting contaminant attribution.

To ensure that "background" well results are suitably free of contamination, careful planning and review of historical data were employed in the selection of suitable sampling locations. In addition, the number of background wells and rounds of sampling will be at least one more than the minimum desired to ensure that meaningful background sampling results are available at the end of all sampling rounds, even if data from one of the background wells were to be discarded as an outlier due to unexpected discovery of localized, non-site-related groundwater contamination. The most important consideration in the selection of background wells for VOC data comparison is to ensure that data are unaffected by other potential sources of contamination. In the case of metals data, an additional consideration will be to attempt to characterize the range and variation in naturally occurring mineral concentrations that are present in off-site wells screened in different lithologic units (e.g., clays, weathered saprolite, etc.).

For a monitoring well that is situated in a unique area of groundwater migration (i.e., not in a similar area of influence as any other monitoring wells), a statistical comparison to background will be attempted. However, there are fewer options that provide a powerful statistical contrast if background and sample results are largely non-detected. The EPA Guidance Document on the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities provides several options for such cases. Where appropriate, (ungrouped) individual monitoring well data will be considered for risk assessment in developing reasonable estimates of maximum exposure (RME).

To estimate maximum potential future exposure and risks resulting from household use of contaminated groundwater, an upper 95 percent confidence limit for the concentration of each chemical of concern in groundwater will be computed for each off-site groundwater well group as defined by hydrogeologic investigation and sampling results. [Calculation of these statistics will be preceded by a careful evaluation of the distributional shape of each type of chemical analytical data (e.g., normal or lognormal).] As explained in Section 3.2, non-carcinogenic risks will be defined by summation of the hazard indices within groups of chemicals that affect the same target organs, physiological process, or metabolic pathway. The potential for adverse non-carcinogenic effects will be ruled out if the resulting hazard index summation for that pathway (or where applicable, combined across pathways consistent with RME assumptions) is less than the reference level of 1.0. Carcinogenic risks will be summed and compared to the target ranges of 10^{-4} to 10^{-6}, which are indicative of the EPA's threshold for consideration as unacceptable risk.

Current exposure risks will be evaluated separately from future exposure risks. For an individual residential well, assessment of current exposure and human health risks will be based upon a RME assumption using the highest of OU-2 RI validated sampling results for that well. For a given residential well, in the event that one or more results from the initial rounds of sampling indicate possible contamination above the health-based criteria listed in Section 3.2, but the highest-level results are not consistent with other rounds of sampling (of this well or in comparison with nearby wells), additional rounds of sampling (up to a total of four) will be included for that well during the OU-2 investigation.

Similar risk assessment evaluations will be performed using the surface/subsurface soil pathway. Confirmatory samples obtained in the areas impacted by the spray irrigation area will provide a quantitative measure of both surface and subsurface contamination that will be used to develop exposure estimates for risk assessment. Analytical data from the surface water/sediment pathway sampling will be compared to AWQC and other criteria described in Section 3.2. Ecological assessment decisions will be based upon the phased approach described in Section 4.3.6.

Decision rules can be summarized as follows:

- Determine if any of the chemicals of concern identified from the OU-1 investigation are present in off-site wells at levels that could present a potential risk to human health.

- If so, group well results for statistical tests for contaminant attribution. Verify contaminant attribution by comparison of various groups of data to background, using either parametric or non-parametric tests, as appropriate.

- Utilize these data in conjunction with hydrogeological studies to establish whether well results are indicative of site-related contamination.

- Modify/augment rounds of sampling if inconclusive results are obtained during initial rounds of sampling.

- Perform similar comparisons to background samples for the surface soil and surface water/sediment pathways.

- Determine whether chemicals of concern for any pathway should be eliminated or added, based upon evaluation of off-site monitoring well results, statistical comparisons, and consideration of hydrogeological tests and historical data. The latest version of the EPA Region 3 Risk-Based Concentration Table will be consulted to aid in screening for additional chemicals associated with significant risk.

- Separately, evaluate current and potential future risks. For the latter, calculate the upper 95 percent confidence interval of groundwater concentrations for each group of wells that are considered potentially similarly affected (based upon hydrogeological considerations). Combine risks across pathways where common receptors exist.

- For any off-site contamination attributed to the site, evaluate remedial alternatives necessary to prevent unacceptable current or future risks to human health or the environment.

3.6.6 Limits on Decision Errors

3.6.6.1 Possible Ranges of Parameters of Interest

Based upon historical data from previous investigations, it is expected that VOC concentrations in off-site locations will be very close to or below the quantitation limit, and a high frequency of non-detected results may occur, even with low detection limit methods. It is possible that inorganic results will also be very close to background levels, and in certain cases (antimony and selenium, for example) non-detected results may comprise the majority of the data obtained for both off-site study samples and background locations.

3.6.6.2 Types of Decision Errors and Potential Consequences

Deciding that a given off-site migration pathway exhibits site-related contamination above levels of concern when the opposite is true would result in additional study and remedial design. It is unlikely that this type of error would result in remediation efforts that inadvertently treat non-contaminated areas or areas affected by sources other than the KSL site, since further studies would be performed in an RD/RA phase before implementation of remedies. Both types of misdirected efforts are considered potentially costly and shoul be prevented or minimized.

Deciding that a given off-site migration pathway is not affected by site-related contamination when th opposite is true could result in either current or future unacceptable risks to human health or th environment. In general, this type of error is treated as the more severe error, especially if human healt risks are at stake.

3.6.6.3 Baseline Hypothesis and Alternative Hypothesis

In accordance with EPA's current DQO guidance, the more severe consequence is considered as the initia (null) hypothesis. This type of statistical test assumes that contamination is significantly greater thar background, and the assumption will be supported (not rejected) if there is a 95 percent probability that a significant difference exists. If this hypothesis is rejected on a statistical basis, then the alternativ hypothesis (no significant contamination) will be considered.

Under the null hypothesis, a false negative is defined as the type of error that occurs when the tes concludes that contamination is not significantly above background, when in reality contamination is attributable to the site. Conversely, a false positive is defined as the error that occurs when the te concludes that contamination is significant relative to background, when in reality there is no site-relatec contamination. False positive results will most likely be investigated further, as discussed in the followin section.

For risk assessment purposes, the assumption that health risks exist will be rejected if either an individual well's maximum detected concentration or if the upper 95 percent confidence limit on a group of wells is less than the criteria listed above. A false negative is defined as the error that occurs when this comparison leads to the conclusion that contamination does not pose significant health risks, when in reality health risks are greater than the threshold criteria. Conversely, a false positive is defined as the error that occurs when the comparison indicates that contamination poses a significant health risk, when in reality there are no significant risks.

3.6.6.4 Limits on Decision Errors

False negative errors in comparing contamination levels to health-based criteria are set in a conservative fashion, in that each step of the process typically utilizes a five percent or less false negative assumption. This leads to a net probability of inappropriately concluding that risks are not significant being far less th five percent. (This is discussed in more detail in the EPA guidance document, RAGS, Volume I, Part A.)

A five percent error rate will be considered as the desired level of significance (α) for comparison of monitoring well results to background. This level of significance must be achieved whenever statistical tests are applied; however, as stated below, background comparison tests will not be possible in some cases where contamination levels are extremely low.

3.6.6.5 Decision Regions Potentially Affected by Uncertainties

Decision uncertainties can be of two types: uncertainties regarding the validity of the model used to test for significance versus purely statistical uncertainties regarding measurements in the populations under comparison. Model uncertainties can be illustrated by consideration of an example where there are multiple potential sources of contamination. In this case, a single comparison of one study location to background may prove only that contamination levels are higher than what is considered to represent background-- but could fail to rule out alternative contamination sources if a particular alternative potential source and contamination pathway were not evident because of lack of awareness and inclusion in the study.

In consideration of the latter type of uncertainty (purely statistical limitations in population measurements), alternative statistical tests will be required if the number of non-detects exceeds approximately 15 percent of the data, as discussed in the EPA Guidance Document on the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Non-parametric tests can be used on larger data sets for frequencies of non-detects up to 50 percent; however, EPA recommends that a test of proportions (percentage of positive versus non-detected results in the two groups) be used if the overall frequency of non-detects exceeds 50 percent. Depending upon the actual collection of positive and non-detected data points obtained, in some cases a 95 percent power will not be able to be achieved due to a comparison of a small set of sample results comprised largely of non-detects against a set of background results. The power of statistical tests in this region will vary according to the concentrations detected and the percentage of non-detected results, with less power the closer results are to the detection limit. It is not possible to construct a single power curve that is valid for all situations, since the percentage of non-detected results will not vary exactly with the median concentration detected. However, the philosophy of the power curve can be applied in that the point where lower power and statistical uncertainty become important is defined on the basis of comparison to the health-based criteria (MCLs and 10^{-4} to 10^{-6} risk levels).

In summary, regions of uncertainty regarding contaminant attribution decisions can be associated with both hydrogeological considerations and purely statistical considerations. Both types of uncertainty are necessary to consider during ongoing study evaluation. For this reason, a dynamic study plan has been developed that will allow proposed expansion and changes to resolve important contaminant attribution questions. In the baseline risk assessment, detected contamination for chemicals of concern will be evaluated using the most appropriate grouping of associated data elements. In keeping with a conservative risk assessment approach, data will not be dropped from the human health evaluation on the sole basis of lack of statistically conclusive contaminant attribution, when other data are available that provid probable cause for inclusion.

3.6.7 Optimization of Design

The overall sampling program for this project can be described as a biased, non-random sequentia approach. This approach is necessary because of the existence of a previous study that identifiec inadequacies (data gaps) in certain distinct areas. The sequential design will be modified after each rounc of sampling to provide the best characterization of complex migration patterns over a large area. A maximum of four rounds of well sampling for groundwater have been established. As discussed in Sectior 4.3.5, residential wells in a key group of locations nearest the site will be sampled throughout all rounds other residential wells will be alternately included or dropped based upon review of data from precedinç rounds. New monitoring wells are being installed where data gaps exist. New and existing off-site monitoring wells will be sampled over four rounds to determine variability and to establish sufficient data to apply statistical tests. As previously discussed, all organic and metals analyses of groundwater will be performed using low detection limit methodologies to ensure that concentrations at the threshold of significant risk may be detected. In addition, inorganic contaminants will be sampled using bladder pumps in order to ensure that constituents detected are representative of those being transported throu groundwater and not suspended solids generated by the sampling process itself.

Surface soil sampling will be optimized by the use of soil gas screening to rapidly survey large areas anc to allow definitive confirmation analysis to be focused in areas needing further characterization. The spray irrigation area and potential drainage pathways will be investigated in this manner. In addition, the methane survey surrounding the site will be conducted in two concentric "rings" so as to minimize grid density and sampling cost, while providing multiple sampling points spaced sufficiently close to ensure that potential gas migration areas surrounding the site are not missed.

Surface water/sediment sampling will be optimized by the use of rounds of sampling, but with locations selected based upon most probable areas of detection (for example, areas near groundwater spring sources, surface runoff sources, or slow/shallow flow areas around bends where contaminant accumulatior would build up in sediments).

The ecological assessment will be conducted using the phased approach discussed in Section 4.3.8 tc ensure that enough data are collected in each step to reliably conclude whether further data collection is needed and to assess any potentially significant ecological risks.

SECTION 4.0

4.0 WORK ASSIGNMENT TASK PLAN

This section presents a description of each task to be performed during the OU-2 RI/FS at the Keystone Sanitation Landfill Site. The rationale for the activities described in these tasks has been presented in Section 3.0. This section summarizes the activities that will be conducted and presents the general sequence in which the events will occur. Table 4-7 (at the end of this section) will present the RI/FS task used in this work plan with the corresponding task from the original EPA statement of work and subsequent modifications.

The RI/FS consists of the standard RI/FS tasks described in Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-01, October 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. The following are the standard RI/FS tasks used in this work plan:

- Task 1 - Project Planning
- Task 2 - Community Relations
- Task 3 - Field Investigation
- Task 4 - Sample Analysis and Data Validation
- Task 5 - Data Evaluation
- Task 6 - Risk Assessment
- Task 7 - Treatability Study/Pilot Testing
- Task 8 - Remedial Investigation Report
- Task 9 - Remedial Alternatives Screening
- Task 10 - Remedial Alternatives Evaluation
- Task 11 - Feasibility Study Report
- Task 12 - Post-RI/FS Support
- Task 13 - Enforcement Support
- Task 14 - Administrative Close-Out

4.1 TASK 1 - PROJECT PLANNING

Task 1 includes the completion of the following activities:

- Site visit.
- Data collection and review.

- Participation in RI/FS scoping session (brainstorming activities).
- Preparation of project work plan.
- Preparation of the sampling and analysis plan (SAP), including the field sampling plan (FSP) and quality assurance progam plan (QAPP).
- Preparation of health and safety plan (HASP).
- Program/project management.

4.1.1 Site Visit

Four site visits were conducted prior to the development of the work plan for the Keystone OU-2 RI/FS.

HNUS conducted an initial site visit in November 1993, during the project scoping phase, in order to develop a conceptual understanding of sources and areas of contamination, as well as potential exposure pathways and receptors at the site. The project manager, community relations coordinator (CRC), and project geologist visited the site and accompanied personnel from EPA, PADER, and MDE during and on-site and off-site reconnaissance to develop a better understanding of the characteristics of the study area and to identify potential data gaps.

A second site visit was conducted by HNUS in November 1993 to provide EPA with technical support in selecting proposed locations for surface water, sediment, and leachate samples. The HNUS project geologist participated in the visit.

Two additional site visits were made by HNUS project members during May 1994 to accompany personnel from EPA's Environmental Photographic Interpretation Center (EPIC) contractor for the purpose of selecting monitoring well locations based on fracture trace analyses. Thirty-eight fracture traces were identified in the study area and were field verified and evaluated to help select the monitoring well locations.

4.1.2 Data Collection and Review

HNUS visited EPA's Region III office in November 1993 and obtained project file information from EPA, including the OU-1 RI/FS reports and the September 1990 ROD for the OU-1 study at the Keystone Sanitation Site. The HNUS project manager met with the EPA RPM to discuss general information about the site to gain a better understanding of the project scope and objectives. A substantial amount of material from the OU-1 RI/FS has been reviewed by the key project participants from HNUS. The OU-1 work plan, Baseline Risk Assessment Report of OU-1, the September 1990 ROD, the Final Remedial Design Work Plan for OU-1 (May 1994), reports generated by the MDE, correspondence, and other pertinent information have been reviewed to develop the project planning documents.

Representatives from the environmental action groups People Against Contamination of the Environment (PACE) and Citizens Urge Rescue of the Environment (CURE) have indicated that additional sample analysis data exist and should be reviewed and evaluated. Arrangements will be made to review the identified data and to interview the environmental group leaders. The collection and review of the data will be scheduled within the first two months after work plan approval so that, if appropriate, the new data can be incorporated into sampling strategies.

Review of new information will be an ongoing process during the OU-2 RI/FS. Data collected during the OU-1 RI/FS will be provided to HNUS for review, and results from OU-2 activities will be shared with the OU-1 project team.

4.1.3 Scoping Activities

Scoping meetings were held in November 1993 and May 1994 to collect input from representatives from Pennsylvania and Maryland and from EPA and HNUS technical staff. The technical scope of work was discussed, and a strategy was developed to address the objectives of the OU-2 RI/FS. The work plan presents this strategy.

4.1.4 Preparation of Work Plan

The work plan defines the scope of work and schedule associated with performing the RI/FS. This work plan includes detailed descriptions of each task to be performed. A draft work plan will be prepared. A final work plan will be prepared reflecting comments from EPA, PADER, MDE, PACE, CURE, and other reviewers.

4.1.5 Preparation of SAP

The SAP consists of two plans, the QAPP and the FSP. Both plans will be submitted as draft reports and will be finalized in response to comments. Both plans are discussed below.

The QAPP includes sampling and analytical objectives; the number, type, and location of all samples to be collected during the field investigation; the site-specific quality assurance requirements (which will be in accordance with the QAPP for the ARCS III program); and detailed procedures for field activities (such as bottle requirements, holding times, preservation requirements, sample nomenclature, etc.).

The FSP includes general field operations for sample identification, handling, packaging and shipping, and documentation; detailed descriptions of all field operations and sampling operations; subtasks of the OU-2 RI field work activities; the sampling equipment decontamination procedure; and references to all applicable standard operating procedures (SOPs) for the field work activities.

4.1.6 Preparation of HASP

The HASP includes site-specific information on health and safety requirements, a hazard assessment, training requirements, monitoring procedures for site operations, safety and disposal procedures, and other requirements in accordance with the HASP developed for the ARCS III program.

4.1.7 Program/Project Management

Program management includes the effort to maintain general program oversight, communicate regularly with the EPA contracting officer and project officer, and prepare monthly progress reports, as well as prepare LOE and financial management summary reports. The program management function is also to conduct regular reviews and status reports for budget, schedule, and scope with the HNUS project manager.

Project management responsibilities involve the routine coordination and oversight of project activities. This includes communication with the EPA RPM and technical staff, as well as with HNUS project personnel. These responsibilities also involve the scheduling of various activities, letter writing, and the completion of project update report.

4.2 TASK 2 - COMMUNITY RELATIONS

Community relations support at the Keystone Sanitation Landfill Site will be a major consideration during the OU-2 RI/FS. Two environmental committees, PACE and CURE, representing residents in the vicinity of the site have been closely involved with the Keystone Sanitation Landfill investigation and are expected to continue their involvement during the OU-2 study. HNUS support will be used to help EPA keep the public well informed and allow the public every practical opportunity to participate in the activities related to the site. However, HNUS has not been tasked to prepare or update the community relations plan.

HNUS has been involved with maintaining the information repositories for the Keystone Site. At EPA's request, HNUS closed two of the four repositories that were in existence for the site and inventoried and indexed the remaining two repositories. To ensure that the remaining repositories were as complete as possible, HNUS made sure that all documents that had been in the two closed repositories were also in the remaining repositories. HNUS will continue to add documents to the repositories as requested by the RPM and will be responsible for updating the index. Occasional visits will be made to the repositories to ensure that they are properly maintained.

HNUS project personnel will attend monthly task force meetings and will assist with preparing and distributing pre- and post-meeting information.

Following the release of the RI/FS for OU-2, HNUS project members will assist in the preparation of the Proposed Plan, which will summarize for the public the remedial alternatives presented in the final FS report and identify the preferred alternative(s) and the reasons it is the preferred alternative(s). The Proposed Plan will set forth the procedures for the public to comment on the alternatives during the public comment period and will indicate the date and location of the public meeting to be held in conjunction with publication of the Proposed Plan.

HNUS project personnel will assist EPA in its preparations for the public meeting required after publication of the Proposed Plan. This assistance will be in the form of provision of technical information and of maps, figures, handouts, or other visual aids developed to supplement presentations given by EPA.

At the end of the public comment period following publication of the Proposed Plan, HNUS will provide technical assistance to EPA in preparing the Responsiveness Summary that will become part of the ROD for OU-2.

HNUS will prepare two fact sheets to update residents and other interested parties on the progress of the OU-2 RI/FS. HNUS will compile the required information into an appropriate format, in coordination with EPA officials, and will respond to EPA comments.

4.3 TASK 3 - FIELD INVESTIGATION

The field investigation for the Keystone Sanitation Landfill Site OU-2 will consist of eight subtasks:

- Procurement of subcontractors
- Mobilization/demobilization
- Soil gas survey
- Hydrogeologic investigation
- Media sampling
- Ecological assessment
- Site survey
- RI waste disposal

4.3.1 Procurement of Subcontractors

Under this subtask, it is assumed that subcontractors will be procured to perform the following tasks:

- Soil gas collection and analysis screening for VOCs and/or methane over a grid outside the landfill fenceline.
- Borehole drilling, packer testing, monitoring well installation and development, collection, containerization, and transportation of all water and cuttings produced by these activities, and site access and restoration for all drilling locations.
- Procurement and installation of dedicated bladder pumps.
- Ground (topographic) surveying to locate all newly installed and existing monitoring wells and piezometers, groundwater spring and seep locations, stream staff gauges, and the new fences surrounding the landfill.
- Remove and properly dispose of investigation-derived wastes (IDW).
- Microfiche all required documents for administrative close-out.
- Connect and disconnect electric utility service to the field office trailer during mobilization and demobilization.

- Connect and disconnect telephone service to the field office trailer during mobilization and demobilization.

- Provide and maintain portable toilet facilities during the period of field activity.

Bid specifications and solicitations will be developed at the earliest possible date for each individual subcontract in order to conform to the RI/FS schedule.

It is assumed that geophysical logging will be performed by the United States Geological Survey (U.S.G.S.) through an interagency agreement with EPA and that HNUS will not be required to procure a subcontractor for this activity. If EPA does not retain the services of the U.S.G.S., HNUS will procure a geophysical subcontractor to perform the borehole logging services.

The cost for each of the subcontracted services and the field oversight of that subcontractor will be budgeted and charged under the specific subtask for that activity. The budget for procuring all subcontractors allows for completion of procurement planning, preparation of bidder's lists, preparation of technical specifications and full solicitation packages, coordination of these specifications and needs with EPA, review of offers, preparation of consent packages as required, awarding of the contract, conduct of routine subcontract administration and management, review of subcontract costs and invoices, and closure of completed subcontracts. The preparation, review, award, and management of these subcontracts will be performed by the HNUS contracting officer, the project manager with assistance from the field operations leader, and the discipline specialists assigned to the project.

Soil Gas Collection and Analysis Screening

Soil gas samples will be collected and analyzed by a subcontractor using either manual slide hammer or truck-mounted direct-push sampling techniques and fast (next-day) turnaround of analytical results or a mobile field laboratory for same-day results. The subcontractor will be required to provide all labor and materials necessary to collect and analyze the soil gas samples; to provide a report detailing the acquisition, analytical techniques, and results of the survey; and to perform any necessary site restoration (including borehole abandonment) following acquisition of the samples.

HNUS will prepare solicitation packages, including a technical scope of work, for this service, evaluate offeror bids, award the subcontract, and maintain subcontractor paper-work and records.

Borehole Drilling, Monitoring Well Installation, and Associated Activities

It is assumed that borehole drilling, packer testing, monitoring well installation and development, and collection, containerization, and transportation of all water and cuttings produced by these activities will be performed by a single subcontractor. The subcontractor will be required to provide all labor and materials necessary to perform these tasks, including any necessary site restoration following the completion of these tasks.

HNUS will prepare solicitation packages including a technical scope of work for these services, evaluate offerer bids, award the subcontract, and maintain the subcontractor's paperwork and records.

Procurement and Installation of Dedicated Bladder Pumps

Low-flow bladder pumps will be installed in any or all of the newly installed monitoring wells as directed by EPA. The subcontractor will be required to provide all labor and materials necessary to supply and install the bladder pumps. HNUS has awarded the subcontract for the initial pump installations (29 wells) and has scheduled the work for July 1994.

Ground Surveying

It is assumed that all existing and newly installed monitoring wells and piezometers used during the OU-2 RI/FS will be surveyed for horizontal control relative to Pennsylvania State Plane Coordinates and for vertical control referenced to U.S.G.S. mean sea level (MSL) elevation datum. The subcontractor will be required to provide all labor and equipment necessary to complete the survey and to provide a detailed report of the methodology, control points, and results.

HNUS will prepare solicitation packages including a technical scope of work for these services, evaluate offeror bids, award the subcontract, and maintain subcontractor paperwork and records.

All of these points will be surveyed by one subcontractor, preferably as a single event. If it is necessary to perform additional surveying during more than one event, the cost and level of effort required for procurement will increase in proportion to the number of surveys required.

IDW Removal and Disposal

It is assumed that most IDW generated during Keystone Sanitation OU-2 field activities will be collected and containerized for disposal at an approved facility. HNUS will prepare solicitation packages for these services, including a technical scope of work, evaluate offerer bids, award the subcontract, and maintain subcontractor paperwork and papers.

Microfiche Documents for Administrative Close-Out

It is anticipated that, at the end of the project, EPA will require that all appropriate file information be microfiched and provided to EPA for storage. HNUS will prepare solicitation packages including technical scopes of work for this service, evaluate offeror bids, award the subcontract, and maintain subcontractor paperwork and records.

Electric Utility Service Connections

Electric service will be required for the field office trailer at the OU-2 base of operations during the entire field work period. It is assumed that connection and disconnection of electric service to the trailer will be performed during the mobilization and demobilization subtask by a single subcontractor who will provide all the necessary labor and materials.

HNUS will prepare solicitation packages for this service, evaluate offeror bids, award the subcontract, and maintain subcontract paperwork and records.

Telephone Utility Service Connection

Telephone service will be required for the office trailer at the field team's base of operations during the entire field work period. It is assumed that connection and disconnection of telephone service to the trailer will be performed during the mobilization and demobilization subtask by a single subcontractor who will provide all the necessary labor and materials.

HNUS will prepare solicitation packages for this service, evaluate offeror bids, award the subcontract, and maintain subcontract paperwork and records.

Sanitary Facilities

Sanitary facilities in the form of a portable toilet will be required at the field team's base of operations during the entire field work period. It is assumed that the delivery, maintenance, and removal of a portable toilet will be performed as part of the mobilization/demobilization subtask by a single subcontractor who will provide all the necessary labor and materials.

HNUS will prepare solicitation packages for this service, evaluate offeror bids, award the subcontract, and maintain subcontract paperwork and records.

4.3.2 Mobilization and Demobilization

Site mobilization will consist of preparation for field activities and includes, but is not limited to, the following activities:

- Obtain all required site access.
- Establish a base of operations.
- Perform all required training and orientation.
- Obtain all equipment required to perform OU-2 RI/FS field activities.
- Identify and prepare locations for all OU-2 RI/FS field activities.
- Coordinate sample types, analyses, and sampling schedule with CLP.

It is assumed that all of the OU-2 RI activities will require permission for access from private land owners and/or municipal authorities. The variety of tasks included in the RI/FS will require access to many of the off-site properties on numerous separate occasions and it may be necessary to obtain land owner permission each time. It will also be necessary to obtain permission to access the on-site and off-site monitoring wells installed by the responsible parties (RPs) for water-level measurements and surveying.

Additional negotiations and arrangements with land owners will be required in order to allow vehicular access to some of the RI/FS activity locations. Such access will definitely be an issue of concern during borehole drilling, packer testing, and monitoring well installation and development and may be a concern if truck-mounted direct-push sampling techniques are used in the soil gas survey. Vehicular access to monitoring well and possibly soil gas survey locations may require the temporary removal of fences, bridging or filling of drainage ditches and culverts, clearing of vegetation, possible crop damage, and the temporary relocation of livestock. It is assumed that these issues must be handled in a manner that is most convenient and satisfactory to the individual land owners and/or tenants and that site restoration will be performed to the land owner's full satisfaction.

It is assumed that a centrally located base of operations will be established within OU-2 for the duration of the RI/FS field work. Such a base must be accessible to a public thoroughfare, reasonably close to electric and telephone utility lines, and in an area where the sights and sounds of normal field work practices are not a nuisance to local residents. The base of operations will be used for ARCS III and subcontractor vehicle parking and as the location of a field office trailer and sanitary facilities, a staging area for ARCS III and subcontractor equipment, and a secure area for sample documentation and equipment decontamination.

HNUS will coordinate the mobilization of a field office trailer, sanitary facilities, and electric and telephone utility hook-ups with the necessary vendors before arriving on site. HNUS will also supervise the location and installation of these facilities or services at the site. It is assumed that EPA will provide assistance in obtaining site access agreements for the base of operations.

As part of establishing a base of operations, HNUS will locate a nearby source of potable water that is satisfactory to EPA for use in personal and equipment decontamination. This water source should also be capable of meeting any needs the subcontractors may have for potable water supplies. HNUS will attempt to arrange for a source that is readily accessible and conveniently located in order to minimize potential delays in the field work schedule. All potable water sources used throughout the course of this investigation will be sampled and analyzed for the same parameters as in the media sampling program.

During the required training and orientation, all field team members, including team subcontractors, will review the work plan and the SAP and will be given site-specific health and safety training based on the HASP. A field team orientation meeting will be held to familiarize personnel with the scope of the RI/FS activities. The orientation will include a drive around the main roads of the area to familiarize personnel with the physical layout of the site and its surroundings.

Orientation and site-specific health and safety training will be performed individually for each of the various subcontractor crews as they mobilize at the site. It will also be necessary to provide orientation and health and safety training for any additional or replacement field team members assigned after the initial mobilization.

HNUS will prepare a list of all equipment and supplies necessary for the field team to perform the OU-2 RI field activities. This list includes but is not limited to

- All documents, forms, logbooks, logsheets, labels, custody seals, airbills, and other paperwork required by the SAP and HASP.
- EPA vehicles for personnel, equipment, and sample transport.
- Personnel and equipment decontamination supplies and equipment required by the SAP and HASP.
- Media sampling field analytical equipment and calibration standards for all required parameters of the SAP.
- Equipment required for IDW waste disposal.
- All required sample containers.
- Equipment and supplies for sample custody, preservation, and packaging.
- Other miscellaneous office and field supplies.

The field team will obtain the required equipment and supplies from the ARCS III warehouse and transport it to and stage it at the OU-2 base of operations. Any equipment not available at the ARCS III warehouse or offices will be purchased or rented by HNUS or its subcontractors. Equipment will be calibrated as required by the SAP and HASP as needed. Equipment will be re-stocked, replaced, or repaired as needed.

Soil gas survey, monitoring well installation, and media sampling locations will be identified, referenced, and marked in the field prior to the start of each subtask. Utility clearances will be obtained for all drilling and soil gas survey locations prior to the onset of these activities. The Pennsylvania One-Call System will be notified for utility clearances within the vicinity of the site. The appropriate agency or individual utility companies in Maryland will be identified and contacted for utility clearances as well.

Site demobilization will consist of removing from the site all facilities, supplies, and equipment no longer needed at the end of field work. Arrangements will be made for the disconnection of utilities and the removal of the field office trailer and sanitary facilities. Materials generated during the investigation, including all IDW, will be removed, secured, or disposed properly. The disposal of IDW will be handled as described in Section 4.3.8. The base of operations and other OU-2 RI work locations will be restored as closely as possible to their original conditions and to the satisfaction of the land owners either by the field team or the responsible subcontractor.

4.3.3 Soil Gas Survey

A soil gas survey will be performed within the OU-2 study area adjacent to and surrounding the landfill. The objectives of this survey are

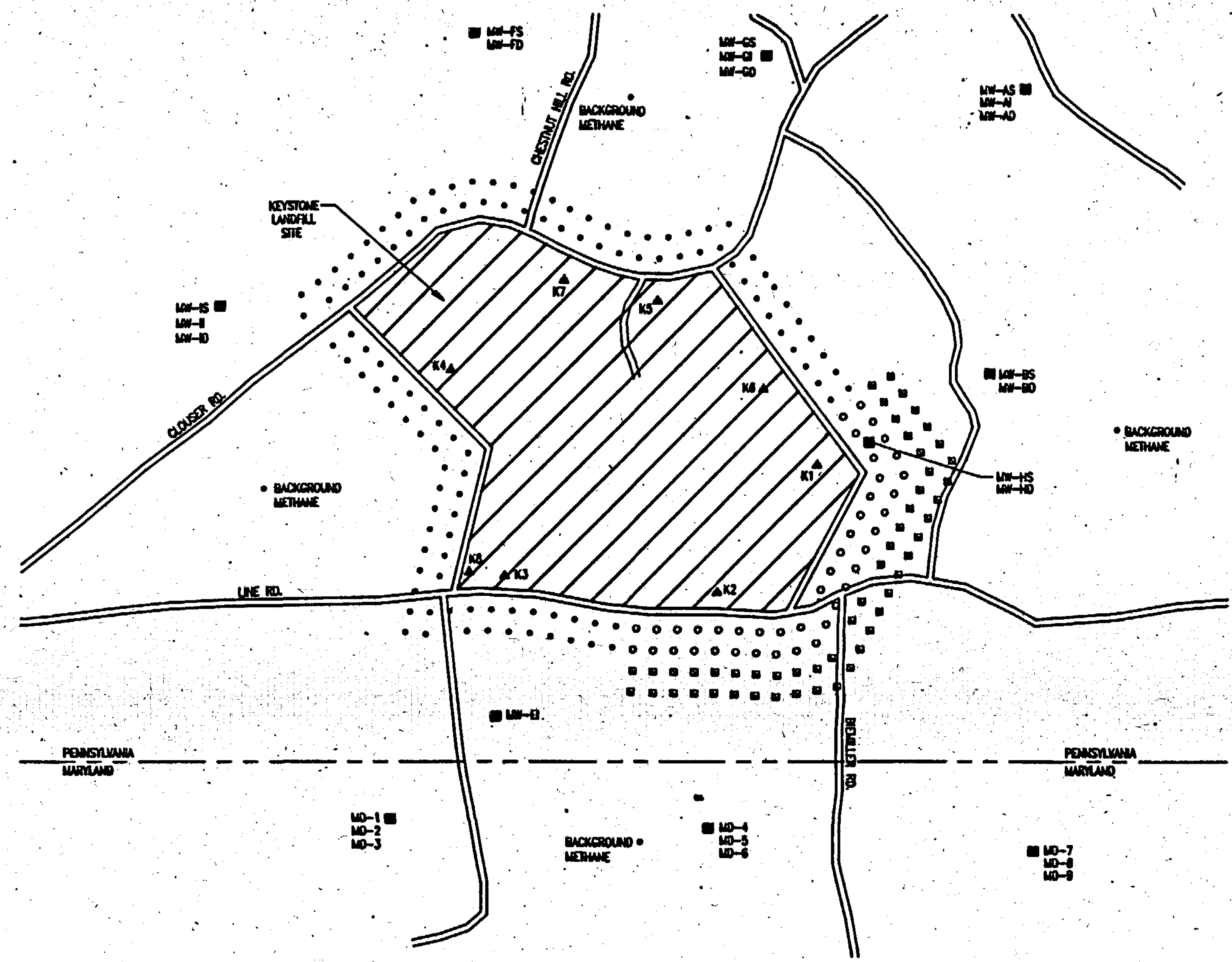
- To determine if methane generated by the landfill is migrating off site and if so where and in what concentrations.

- To determine if the operation of the former spray irrigation system has resulted in the VOC contamination of adjacent off-site soils through the transport of contaminated groundwater (either by wind transport of the spray water or the surface runoff of the spray water).

To investigate for the potential off-site migration of methane, two continuous lines of sample points will be sampled completely around and adjacent to the landfill. The sample points will be spaced at a nominal distance of 100 feet; the two "rings" of sample points will also be separated by a nominal distance of 100 feet (see Figure 4.1). In addition, four samples will be collected between 500 and 1,000 feet north, east, south, and west of the landfill to determine an average background value or range of values locally for methane.

Each soil gas sample will be analyzed for methane concentration. If significant levels of soil gas methane are detected in these initial locations, the survey area will be extended away from the landfill as necessary until background or non-detection levels are obtained. Estimates of soil permeability and pore pressure will be obtained at each sampling point in order to determine soil gas velocities and any preferred direction(s) of gas flow.

To investigate if the operation of the former spray irrigation system has resulted in the VOC contamination of adjacent off-site soils, soil gas samples in the vicinity of the former system will be analyzed for a target suite of VOCs. The target suite of VOCs includes vinyl chloride, TCE, PCE, 1,1,1-trichloroethane (1,1,1-TCEA), 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCEA), trans-1,2-dichloroethene (trans-1,2-DCE), benzene, toluene, ethylbenzene, xylene, and methylene chloride. These target compounds were selected based on their occurrence in groundwater samples obtained from on-site wells. The sample points to be analyzed for VOCs include those of the initial sampling "ring" along the southern and southeastern



LEGEND

- • SCREEN FOR METHANE
- o SCREEN FOR METHANE AND VOC'S
- ▪ SCREEN FOR VOC'S (METHANE IF NECESSARY)

MW-EI ■ OFF SITE MONITORING WELLS

K6 ▲ ON SITE MONITORING WELLS

FIGURE 4-1

0 500 1000
SCALE IN FEET (APPROXIMATE)

PROPOSED SOIL GAS SAMPLE LOCATIONS
KEYSTONE LANDFILL

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CORPORATION

portions of the landfill, from an area north of on-site monitoring well K1 tothe center of the southern landfill boundary along Line Road (see Figure 4.1). An additional outer grid of soil gas sample locations will span this same VOC area to a distance 200 feet farther from the site.

All soil gas samples will be obtained from a subsurface depth of three feet. The samples will be obtained either by manual (e.g., slide hammer) or direct-push (e.g., "Geoprobe") methods. The samples will be analyzed by a gas chromatograph (GC) either at the subcontractor's laboratory with a one-day turnaround time for results or in a mobile field laboratory with same-day results. The initial soil gas grid will contain approximately 210 sample locations. It is assumed that no more than 50 additional samples will be taken if the survey is required to move out from the initial sampling "ring" in order to reach background conditions. It is estimated that about 30 soil gas samples can be obtained and analyzed per day and that the entire survey, including mobilization and demobilization, will be completed in two weeks. Inclement weather has the potential to significantly affect this schedule because saturated soil conditions are not favorable for soil gas sampling and analysis. The sampling and analysis program for the soil gas survey is presented in Table 4-1.

The roads and fences surrounding the landfill are assumed to represent the site boundaries for purposes of the soil gas survey layout. It is also assumed that site access can be obtained for all properties covered by the survey. The sampling locations will be modified as necessary to avoid surface and subsurface obstructions. Paved surfaces of roads and driveways will not be penetrated. All necessary utility clearances will be obtained prior to the collection of any soil gas samples. All sample locations will be measured relative to fixed reference points (e.g., the landfill fence) so that accurate maps of the results can be constructed.

HNUS and the ARCS III field team will lay out the initial soil gas grid, obtain site access, provide subcontractor oversight, and provide the necessary health and safety training and monitoring. The subcontractor will obtain and analyze all soil gas samples, measure the final soil gas survey locations, perform any necessary site restoration, and provide a report of the methodology, operations, and results.

Information obtained from the soil gas survey will be used to direct soil sampling activities discussed in Sections 4.3.5.1 and 4.3.5.2.

TABLE 4-1
SUMMARY OF SAMPLING AND ANAYLYSIS PROGRAM FOR SOIL GAS
KEYSTONE SANITATION LANDFILL SITE

Sample Description	Analytical Parameters	Analytical Methods	Analytical Options	Data Use	Number of Samples	Field Dups	Equip Blank	Equip Purge
Soil Gas	Methane	Screen/Direct Injection	Screening data with definitive confirmation	A	210	13	13	7
	Vinyl Chlorida	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	TCE	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	PCE	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	111-TCEA	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	11-DCE	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	11-DCEA	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	trans 12-DCE	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7

TABLE 4-1
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM FOR SOIL GAS
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 2

Sample Description	Analytical Parameters	Analytical Methods	Analytical Options	Data Use	Number of Samples	Field Dups	Equip Blank	Equip Purge
Soil Gas (continued)	Benzene	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	Methylene Chloride	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	Toluene	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	Ethylbenzene	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7
	Xylene	Modified EPA 601	Screening data with definitive confirmation	A	210	13	13	7

4.3.4 Hydrogeologic Investigation

The primary goal of the hydrogeologic investigation is to assess the degree to which the landfill may be contributing to off-site groundwater contamination. This will be accomplished by more fully characterizing the groundwater flow regime in the vicinity of the landfill and integrating these data with multiple rounds of analytical data to produce a comprehensive, three-dimensional analysis of groundwater flow and groundwater quality. The following objectives must be met to accomplish this goal:

- Further characterize the vertical and horizontal nature and extent of off-site groundwater contamination in the vicinity of the Keystone Sanitation Landfill.

- Better define the local hydrogeological regime, including the horizontal and vertical components of groundwater flow and the degree of interconnection (both horizontal and vertical) of the water-bearing zones within the aquifer.

- Assess the role of the off-site surface water bodies as groundwater divides and discharge points for groundwater, and assess to what extent hazardous substances releases from the landfill may be impacting the water quality of these bodies.

The following tasks will be performed to meet the objectives of the hydrogeologic investigation:

- Perform a complete inventory of all on-site and off-site monitoring wells and piezometers.

- Drill and install 18 new monitoring wells at seven locations.

- Perform geophysical logging in the monitoring well boreholes to identify and characterize the aquifer water-bearing zones.

- Perform aquifer tests to determine the hydraulic characteristics of the aquifer.

- Collect two rounds of groundwater samples from 29 existing off-site monitoring wells and two rounds of groundwater samples from the 18 new monitoring wells.

- Collect two rounds of groundwater samples from approximately 30 off-site residential wells.

4.3.4.1 Monitoring Well and Piezometer Inventory

The historical analytical data that were compiled and reviewed during the development of this work plan are listed and discussed in Section 3.1. As additional documents have been received and reviewed, it has become apparent that many other off-site monitoring wells exist within the immediate vicinity of the landfill in addition to the 20 wells installed during the RI and the nine wells installed by the state of Maryland. At least 26 monitoring wells (14 "C-Series," six "A-Series," and six "B-Series") have been installed adjacent to the eastern boundary of the landfill. An unknown number of additional wells and/or piezometers have been installed north, northeast, and east of the landfill for a planned landfill expansion.

These wells are expected to provide additional information regarding off-site contaminant presence and concentrations, off-site geology and aquifer properties, and water levels. The data generated by the monitoring well and piezometer inventory will be used to help create a comprehensive data base of all monitoring wells and piezometers in the study area. The following information will be obtained and cataloged for each well, where available:

- Reports, correspondence, or records of the well and piezometer installation including location maps, geologic logs, well construction details, and aquifer test data.

- Survey data, including reference (top of casing) elevation, ground elevation, and surface location.

- Analytical results from previous sampling rounds.

Once the well data have been compiled, HNUS will conduct a field verification program in order to

- Verify the location, condition, and accessibility of all wells.

- Obtain field measurements of the well including total depth; static water level; riser material, diameter, and stick-up; protective casing material, diameter, and stick-up; and other observations regarding the general condition and security of the well.

It is assumed that the reports, correspondence, or records necessary for this task can be located in either the administrative record file for the site or by contacting state environmental officials. It is also assumed that site access can be obtained for all locations of the field verification activity and that well keys can be obtained or permission will be granted to cut off and replace any frozen locks or locks for which keys cannot be obtained.

4.3.4.2 Drilling and Installation of Monitoring Wells

Monitoring wells will be installed during the OU-2 RI/FS to address the data gaps and data needs as identified during the scoping activities and summarized below.

The monitoring wells will be installed within target depth intervals based on the data needs for each particular location. The shallow wells will be installed to intercept the water table, which typically is located within the saprolite and weathered bedrock. The shallow wells, in general, will be 50 feet deep, or less.

The intermediate wells will be installed to monitor the groundwater within the shallow, fractured bedrock zone. The depths of the intermediate wells will approximate the depths of many of the residential wells and will generally be between 80 and 150 feet deep.

The deep wells will be installed to monitor the groundwater within the deeper, less fractured bedrock. The depths of these wells will vary based on location but generally will be between 150 and 400 feet.

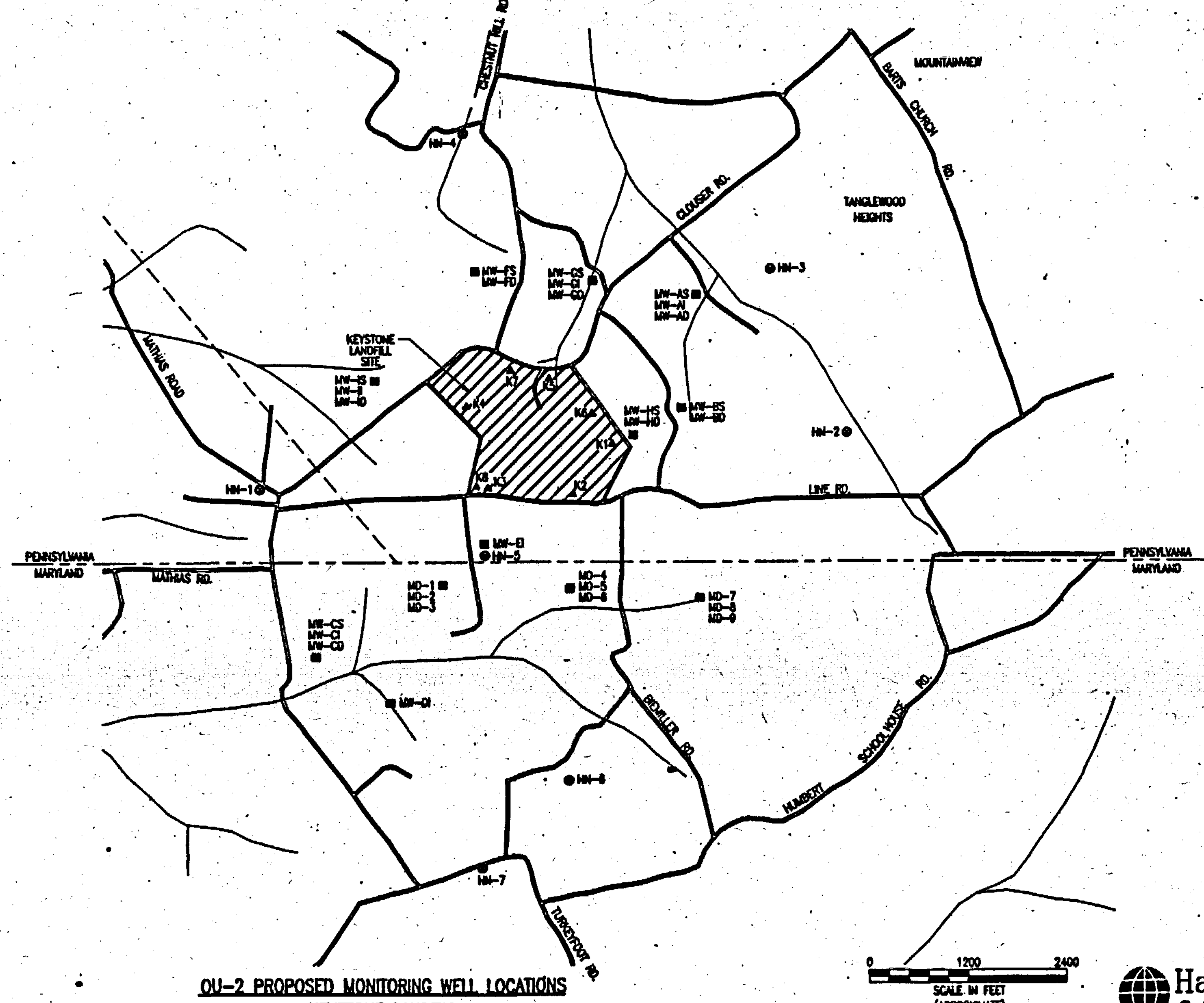
The target depth intervals are used only as guidelines during the installation of the monitoring well network. The actual depths of the wells will be determined by the depths that significant water-bearing zones are encountered in the borehole, as determined by the observations of the field geologists and by the results of the geophysical logging program. For example, if the water table at a particular location occurs within the shallow fractured bedrock, then two wells may potentially be installed within that interval if a second significant water-bearing zone is encountered.

A total of 18 monitoring wells are proposed for installation during the current field investigation. The proposed well locations are illustrated in Figure 4.2.

- Twelve of the monitoring wells will be installed at four separate locations as clusters consisting of shallow, intermediate, and deep bedrock monitoring wells.

- Four of the wells will be installed at two separate locations as clusters consisting of shallow and deep monitoring wells.

- The remaining two wells will be installed as a shallow and deep well paired with existing intermediate well MW-EI to complete this cluster.



OU-2 PROPOSED MONITORING WELL LOCATIONS
KEYSTONE LANDFILL

LEGEND

- HN-3 PROPOSED MONITORING WELL LOCATION
- K2 ON SITE MONITORING WELL LOCATION
- MD-7 OFF SITE MONITORING WELL LOCATION

FIGURE 4-2

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EPA 210647

A. Well Location and Rationale

Monitoring Well Cluster HN-1

Monitoring well cluster HN-1 will consist of a shallow, intermediate, and deep monitoring well. This cluster will be installed approximately 2,400 feet west of the landfill and adjacent to Mathias Road (Figure 4.2). The primary purpose for installing this cluster is to obtain groundwater quality and hydraulic information for the off-site area west of the landfill, where these data are lacking. Location HN-1 is near the eastern end of an east-west-trending fracture trace identified in the EPIC study and field verified during the subsequent site reconnaissance. The preferred location for cluster HN-1 was just west of the current location, near the intersection of this fracture trace with one trending northwest-southeast. Access to this location, however, has currently been denied by the land owner.

Monitoring well cluster location HN-1 is located west-northwest of Maryland wells MD-1, MD-2, and MD-3, where persistent low levels of groundwater contamination have been detected. Wells at the HN-1 location will be used to determine the nature and extent of off-site groundwater contamination in this vicinity along a possible avenue of preferential groundwater flow. The wells will also be used to provide additional piezometric surface and vertical hydraulic gradient control to further delineate off-site groundwater flow directions and rates.

Monitoring Well Cluster HN-2

Monitoring well cluster HN-2 will consist of a shallow, intermediate, and deep monitoring well. This cluster will be installed east of the landfill and southeast of existing off-site well clusters H and B (Figure 4.2). The primary purpose for installing this cluster is to obtain groundwater quality and hydraulic information for the off-site area east-southeast of the landfill, where these data are lacking. Location HN-2 is located along an east-west-trending fracture trace identified in the EPIC study and field verified during the subsequent site reconnaissance. The preferred location for the well cluster is approximately 1,700 feet east of the landfill near the center of the fracture trace where the surface expression is the greatest. The alternate location is approximately 2,500 feet east of the landfill near the eastern end of the fracture trace, just west of the unnamed tributary to Conewago Creek. Preliminary land owner permission has been obtained for these locations. The final well locations will be chosen after issues of site access such as crop damage and reimbursement for damage have been addressed.

Monitoring well cluster location HN-2 is located along a fracture trace east of the highest levels of on-site groundwater contamination (in on-site well K1) and lower levels of off-site groundwater contamination in well cluster H and the Mundorff Spring and numerous other wells installed east and downgradient of the landfill. Monitoring well H-Deep was constructed to monitor the groundwater from the subsurface interval of 130 to 160 feet. The groundwater sample analyzed from this well contained eight different organic contaminants, several of which were above the MCL. The full extent of the groundwater contamination in this area, therefore, has not been determined. Wells at the HN-2 location will be used to determine the nature and extent of off-site groundwater contamination in this vicinity along a possible avenue of preferential groundwater flow. The wells will also be used to provide additional piezometric surface and vertical hydraulic gradient control to further delineate off-site groundwater flow directions and rates and will investigate possible groundwater discharge relationships to the unnamed tributary to Conewago Creek.

Monitoring Well Cluster HN-3

Monitoring well cluster HN-3 will consist of a shallow, intermediate, and deep monitoring well. This cluster will be installed northeast of existing off-site well cluster A on the opposite (eastern) side of the stream valley for the unnamed tributary for Conewago Creek (Figure 4.2). The primary purpose for installing this cluster is to obtain additional groundwater quality and hydraulic information for the off-site area northeast of the landfill. Location HN-3 is located at the intersection of east-west-trending and northeast-southwest-trending fracture traces identified in the EPIC study and field verified during the subsequent site reconnaissance. Access for this location has been obtained from the landowner.

Monitoring well cluster location HN-3 is located northeast of the highest levels of on-site groundwater contamination (in on-site well K1) along the northeast-southwest-trending strike of the bedrock cleavage or schistosity, which has been shown to be a preferred pathway for groundwater migration. Wells at the HN-3 location will be used to determine the extent of off-site groundwater contamination in this vicinity along possible preferential avenues (bedrock cleavage and fractures) of groundwater flow. The wells will also be used to provide additional piezometric surface and vertical hydraulic gradient control to further delineate off-site groundwater flow directions and rates.

The hydraulic head data obtained from this cluster and other, existing clusters will be used to evaluate the role of the unnamed tributary for Conewago Creek as a discharge point for groundwater. If the stream effectively acts as a discharge point or "barrier" for groundwater flow, then cluster HN-3 may be used to determine background water quality conditions. If groundwater from the deeper zones is found to be flowing beneath the stream, then this cluster (due to its location) will serve to monitor the groundwater quality along a possible preferential flow path between the site and the new developments of Tanglewood and Fox Run developments, where potable water supplies are also obtained from private residential wells.

Monitoring Well Cluster HN-4

Monitoring well cluster HN-4 will consist of a shallow, intermediate, and deep monitoring well. This cluster will be installed north-northwest of the landfill and approximately 1,800 feet north of existing well cluster F (Figure 4.2). The primary purpose for installing this cluster is to obtain additional groundwater quality and hydraulic information for the off-site area west-northwest of the landfill. Location HN-4 is located along a north-south-trending fracture trace identified in the EPIC study and field verified during the subsequent site reconnaissance. This fracture trace cuts across the strike of the bedrock cleavage or schistosity and extends across the mapped geologic contact between the Marburg Schist and the sedimentary rock formations located northwest of the site. Location HN-4 is located on or very near the mapped geologic contact between the Marburg schist and the adjacent sedimentary formations (Figure 2.4). Well cluster F, located between proposed cluster HN-4 and the landfill, is not located on the mapped fracture trace.

Wells at the HN-4 location will be used to determine the nature and extent of off-site groundwater contamination in this vicinity along a possible avenue of preferential groundwater flow. The wells will also be used to provide additional piezometric surface and vertical hydraulic gradient control to further delineate off-site groundwater flow directions and rates.

Monitoring Well Cluster HN-5

Monitoring well cluster HN-5 will consist of a shallow and deep monitoring well to be installed near existing well E-l in order to complete this cluster (Figure 4.2). This cluster is located between on-site wells K-1 and K-2 and off-site wells MD-1 through MD-3 and is located along the same structural trend of bedrock cleavage or schistosity. Wells K-1 and K-2 have historically exhibited the highest levels of on-site organic groundwater contamination, and wells MD-2 and MD-3 (which are intermediate and shallow wells) have consistently exhibited the highest levels of off-site organic groundwater contamination.

The RI indicated that the E-l and MD-1 through MD-3 monitoring well locations are located hydraulically downgradient of on-site well K-2. These data, coupled with the analytical results discussed in the preceding paragraph, indicate a potential plume of contaminated groundwater flowing from the site into Maryland. Monitoring well E-l, however, did not contain any organic contaminants when sampled during the RI. Additional sampling and studying of this area will be conducted to study the hydrogeologic interconnection between this area and the eastern portion of the landfill.

Wells at the HN-5 location will be used to determine the nature and extent of off-site groundwater contamination along a possible avenue of preferential groundwater flow, and they will investigate the possible hydrogeological interconnection between the eastern portion of the landfill and the Maryland well cluster. The wells will also be used to provide additional piezometric surface and vertical hydraulic gradient control to further delineate off-site groundwater flow directions.

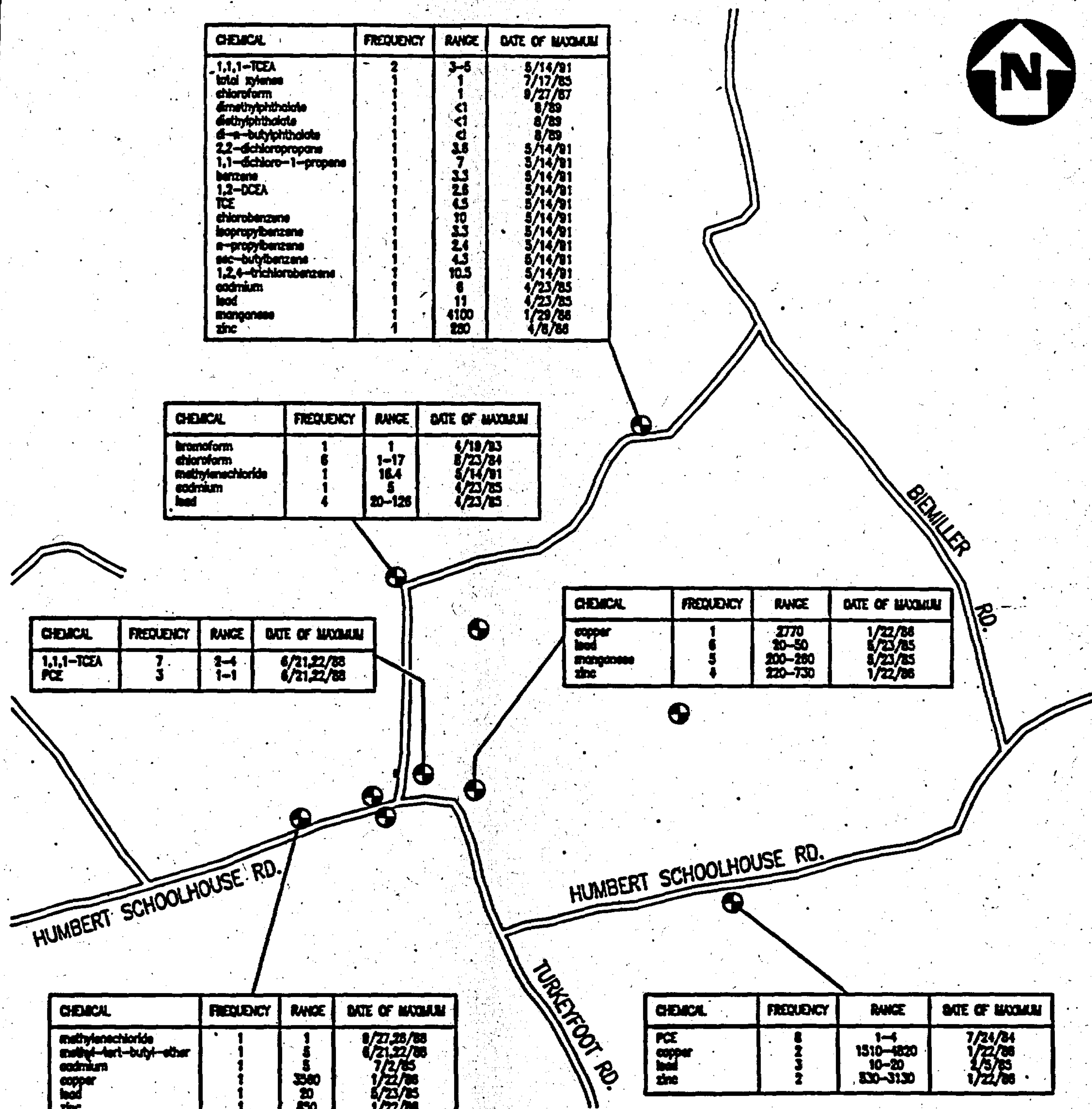
Monitoring Well Clusters HN-6 and HN-7

Monitoring well clusters HN-6 and HN-7 will each consist of a shallow and a deep monitoring well (Figure 4.2). The primary purpose for installing these clusters is to more fully define the nature and extent of off-site contamination attributable to the landfill by determining the vertical extent of groundwater contamination and the vertical and horizontal components of groundwater flow in the Humbert Schoolhouse Road area, where groundwater contamination has been historically noted in several wells (Figure 4.3).

Data generated during previous investigations indicate that the unnamed tributary to Piney Creek serves as a local groundwater divide (see Section 2.4.2). This stream flows within the valley between the landfill and Humbert Schoolhouse Road and is the likely discharge point for the majority of groundwater flowing south from the landfill. Two reports, however, have commented that contaminated groundwater in the deeper aquifer zones could be flowing beneath this stream.

The state of Maryland (1986, 1989) has concluded that the landfill could not be responsible for the contamination along Humbert Schoolhouse Road because the groundwater (at least to the depths of the residential wells) flows to the north, toward the unnamed tributary to Piney Creek. These reports, however, have relied on, among other data, the general assumptions that the water table is a subdued reflection of the surface topopgraphy and that surface water bodies serve as discharge points for groundwater or have constructed potentiometric maps using estimated static water elevations in residential wells based on approximate surface elevations as interpolated from topographic maps and/or static water elevations obtained from open boreholes, which could possibly be composited or averaged over several water-bearing intervals. These assumptions, while generally valid, are insufficient to adequately evaluate the landfill as a contributor to the observed contamination.

The monitoring wells will be constructed to monitor only a specific water-bearing interval. The shallow wells will monitor the vertical sequence that contributes the bulk of the groundwater to the residential wells. The deep wells will be drilled to a target depth of 400 feet to monitor the approximate vertical sequence that is monitored by the deep wells within the valley of the unamed tributary to Piney Creek. The wells will be surveyed in order to accurately determine the static water elevation (and potential) of that interval. By these means, the general direction of groundwater flow relative to the Humbert Schoolhouse Road ridge and the valley for the unnamed tributary for Piney Creek will be established.



CHEMICAL	FREQUENCY	RANGE	DATE OF MAXIMUM
1,1,1-TCEA	2	3-5	5/14/91
total xylenes	1	1	7/17/85
chloroform	1	1	9/27/87
dimethylphthalate	1	<1	8/89
diethylphthalate	1	<1	8/89
di-n-butylphthalate	1	<1	8/89
2,2-dichloropropane	1	3.8	5/14/91
1,1-dichloro-1-propene	1	7	5/14/91
benzene	1	3.3	5/14/91
1,2-DCEA	1	2.6	5/14/91
TCE	1	4.5	5/14/91
chlorobenzene	1	10	5/14/91
isopropylbenzene	1	3.3	5/14/91
n-propylbenzene	1	2.4	5/14/91
sec-butylbenzene	1	4.3	5/14/91
1,2,4-trichlorobenzene	1	10.5	5/14/91
cadmium	1	6	4/23/85
lead	1	11	4/23/85
manganese	1	4100	1/29/86
zinc	1	250	4/6/86

CHEMICAL	FREQUENCY	RANGE	DATE OF MAXIMUM
bromoform	1	1	4/19/83
chloroform	6	1-17	8/23/84
methylenechloride	1	16.4	5/14/91
cadmium	1	5	4/23/85
lead	4	20-126	4/23/85

CHEMICAL	FREQUENCY	RANGE	DATE OF MAXIMUM
1,1,1-TCEA	7	2-4	6/21,22/88
PCE	3	1-1	6/21,22/88

CHEMICAL	FREQUENCY	RANGE	DATE OF MAXIMUM
copper	1	2770	1/22/86
lead	6	20-50	5/23/85
manganese	5	200-260	5/23/85
zinc	4	220-730	1/22/86

CHEMICAL	FREQUENCY	RANGE	DATE OF MAXIMUM
methylenechloride	1	1	8/27,28/88
methyl-tert-butyl-ether	1	5	6/21,22/88
cadmium	1	5	7/2/85
copper	1	3360	1/22/86
lead	1	20	5/23/85
zinc	1	850	1/22/86

CHEMICAL	FREQUENCY	RANGE	DATE OF MAXIMUM
PCE	8	1-4	7/24/84
copper	2	1510-4820	1/22/86
lead	3	10-20	2/5/85
zinc	2	530-3130	1/22/86

LEGEND

⊕ RESIDENTIAL WELL

NOTE: ALL CONCENTRATIONS IN ppb

0 600 1200

SCALE IN FEET
(APPROXIMATE)

FIGURE 4-3

RESIDENTIAL WELL SAMPLING RESULTS:
HUMBERT SCHOOLHOUSE ROAD
KEYSTONE LANDFILL

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B. Well Materials

All monitoring wells will be constructed with two-inch-diameter, Schedule 40, polyvinyl chloride (PVC) well casing and well screen.

The monitoring wells installed during the previous RI were constructed with stainless-steel casing and screen due to concerns that VOCs could be leached from the well materials and interfere with the analytical sampling. A preliminary review of the existing analytical data base, however, indicates that the maximum levels of off-site volatile organic contamination are relatively low. According to published studies, PVC is more susceptible to chemical attack at high concentrations of certain organic solvents. The effects of a long-term exposure to lower levels of solvent concentration, however, are not documented, and there is a lack of information regarding the critical concentrations at which deterioration of the PVC may be significant enough to affect the quality of the analytical sample.

These same reports state that stainless-steel screens may be leached of certain metals, particularly chromium and nickel, under corrosive conditions. Corrosive conditions are generally defined as groundwater pH of less than 7.0. A review of groundwater chemistry at and near the site indicates that groundwater pH of less than 7.0 is common. A recent study and series of experiments concluded that "common stainless steel well screens significantly affect solution metal concentrations under dynamic conditions consistent with typical ground water sampling protocol. The magnitude of the influence appears directly correlated with the presence of corrosion products on stainless steel casings, and concentrations of Ni (and perhaps Cr) could approach those that would affect regulatory compliance."

There are advantages and disadvantages to all well materials. Many solvents have been selected as contaminants of concern for the groundwater medium at this site (ROD). Many metals, however, (including nickel and chromium) have also been selected as contaminants of concern for the groundwater medium. Upon review of the historical analytical data, it is believed that the potential introduction of metals from the stainless-steel into the groundwater is more likely to occur and is more of a concern than the introduction of organic compounds from the PVC into the groundwater.

The well screen will have a slot size of 0.020 inch. The filter pack will be composed of No. 2 Morie sand, or equivalent.

C. Drilling Method

All boreholes will be drilled by the air-rotary or air-percussion drilling method. The use of an air drilling method should allow for the field recognition of water-bearing zones by an increase in the yield of the well when such a zone is penetrated.

All compressors used to supply air to the drilling rig will be equipped with in-line filters to remove all traces of oil from the air stream before it is introduced into the borehole. These filters will be inspected daily and will be replaced as necessary.

If insufficient water is encountered within the borehole, it may become necessary to add water to the borehole in order to circulate and remove the drill cuttings. This problem typically increases with increasing borehole depth. Only clean, potable water shall be introduced into the borehole. A field blank will be obtained for the source(s) of all potable water introduced into the borehole. The amount of water added will be noted by the field geologist and entered on the log sheet.

All boreholes will be geophysically logged in order to determine and/or identify various hydrogeological characteristics such as lithology, fractures, and water-bearing zones. These data, combined with the oberservations recorded by the field geologist during the drilling of the borehole, will determine the construction characteristics (depth, screen interval) for the well to be installed in that particular borehole. The geophysical logging program is discussed in Section 4.3.4.4.

D. Well Construction

Any open borehole below the interval to be monitored will be backfilled before the well is constructed. The backfill material will consist either of 100 percent, polymer-free natural bentonite emplaced as chips or a bentonite-cement grout.

The length of the well screen for each well will vary and will be dependent on the length of the interval to be monitored. In general, it is anticipated that no more than 15 feet of well screen will be used for any well since an objective of this investigation is to monitor discrete water-bearing intervals. The sand pack will extend for an interval from approximately five feet below the well screen (if the borehole must be backfilled to the monitored interval) to a height of approximately three feet above the well screen. The length of the filter pack may be extended in lieu of additional well screen if an extended vertical sequence must be monitored for any particular borehole.

An annular seal composed of bentonite will be emplaced above the well screen. The bentonite will be allowed to hydrate per the manufacturer's recommendations prior additional well construction. The remainder of the annulus shall be sealed with either a 100 percent, polymer-free natural bentonite emplaced as chips or with a bentonite-cement grout to a height of approximately two feet below the ground surface. A concrete collar will be installed from this height to the surface and around either a steel protective standpipe or a manhole cover, depending on the type of surface completion.

All wells will be developed with a submersible pump. Air-lifting will not be allowed. A surge block will be used as an aid in well development, if necessary. The groundwater pH, temperature, conductivity, and turbidity will be monitored during development. Well development will continue until these monitored parameters stabilize (generally, until three consecutive measurements fall within 10 percent of each other). The field geologist will record all measurements on the well development log.

4.3.4.3 Geophysical Borehole Logging and Packer Testing

Geophysical Borehole Logging

A geophysical logging program will be conducted for each borehole. Packer tests may be perfomred on selected boreholes, as necessary. The primary purpose for conducting this program is to identify the major water-bearing zone(s) in each borehole and to assure that the monitoring wells are properly constructed to obtain groundwater from the intervals selected. The information obtained by the geophysical logging program will be used in conjunction with the observations noted by the field geologist during the drilling of the borehole and the results of any packer testing to select the vertical interval to be monitored. The following text describes the geophysical logging tools to be used and provides the rationale for their use.

Natural Gamma Log

The natural gamma logging instrument records the amount of natural gamma radiation emitted by the geologic formation. This log has been used during previous site investigations as an aid in locating probable fracture zones. Fine-grained rocks such as clays and shales typically have high natural gamma activity because they tend to concentrate radioactive elements through the processes of ion exchange and absorption. Minerals such as quartz (which may precipitate in a fracture) tend to have very low natural gamma activity.

Borehole Caliper Log

The borehole caliper log measures the diameter of the borehole. This log is useful in locating fractures because the borehole tends to enlarge or "wash out" through fractured intervals due to the relative weakness of the rock as compared to unfractured rock.

Single-Point Resistance Log

The single-point resistance log measures the resistance of the formation(s) lying between a downhole electrode and a surface electrode. A primary use of resistance logs is the identification of fractures or washout zones in resistive rocks.

Fluid Temperature and Fluid Conductivity Logs

These logs, usually run together, yield a vertical profile of the fluid temperature and conductivity within the borehole. These logs are often useful in determining water entry or exit zones within the borehole because such a zone may cause a marked deflection in the vertical trend.

Borehole Television Camera

A borehole television camera will be run in all boreholes to allow visual observation of the borehole conditions. Fractures will be examined for general width, orientation, and openness as an aid in their evaluation as potential zones to be screened. In addition, a qualitative visual assessment of water clarity with depth often allows for preliminary identification of zones of groundwater flow versus "dead" zones of no or little flow. All television surveys will be recorded on VCR-compatible tape cassettes.

Packer (Pressure) Testing Program

Pressure tests will be conducted on selected boreholes if the results of the drilling program (including the field geologist's observations and the borehole geophysical logging) yield inconclusive results concerning the prospective intervals to be monitored. Pressure tests are not proposed as a standard procedure for every borehole because they involve the introduction of fresh, potable water into the formation under pressure. It is believed that the introduction of this water into the formation may potentially interfere with subsequent analytical testing due to the relatively low levels of contamination and the overall low hydraulic conductivity of the formation. If a pressure test is conducted, it will be of a generally qualitative nature ar will be used solely to determine if the interval of interest will accept water and to estimate the approximat potential yield of that interval. An extended pressure test capable of yielding hydraulic parameters will not be conducted because of the concerns noted above for introducing a large amount of fresh water into the formation.

As an alternative to the pressure testing, a packer (pumping) testing program may be considered. Packers will be used to isolate the interval(s) of interest. A variable-yield submersible pump will stress the packed interval at varying rates in an attempt to determine the approximate yield of that interval. The yields of the tested zones within the borehole would then be used in conjunction with the field geologist's observations and the results of the borehole geophysical logging to select the appropriate interval within the borehole to be monitored.

4.3.4.4 Aquifer Testing

The hydraulic characteristics of the aquifer will be determined through the performance of appropriate aquifer tests and/or the evaluation of tests performed as part of the RD investigations for OU-1. Slug tests will be performed on all newly installed monitoring wells. Three comprehensive rounds of water level measurements will be performed concurrent with the media sampling. The need for additional aquifer testing will be considered as the field work progresses and the preliminary data, including the slug tests, are reviewed and evaluated. The potential additional aquifer tests to be considered include aquifer pumping tests (including step-drawdown testing) and tracer testing.

1. Slug Tests

Slug tests will be performed in all 18 monitoring wells installed during this investigation in order to determine the permeability characteristics of the bedrock in the immediate vicinity of the borehole. The slug tests will be conducted by introducing a cylinder of known volume into the well to induce a rise in the water level and then monitoring the rate at which the water level falls. No water shall be either introduced into or removed from the wells during the performance of the slug tests.

2. Water-Level Measurements

Three comprehensive rounds of water-level measurements will be taken concurrent with media sampling from the new monitoring wells, all existing off-site and on-site monitoring wells and piezometers, and the stream staff gauges and spring locations. All measurements for each round will be collected within a limited time span during a period of consistent weather conditions to minimize atmospheric or precipitation effects on groundwater levels; the water levels will be obtained a minimum of 24 hours after any significant precipitation event. The water-level measurements will be made relative to the surveyed point on the well casings. The measurements will be made to the nearest 0.01 inch with an electronic sounding device. The static water levels will be converted to elevation and will be used to determine groundwater flow directions (both horizontal and vertical) and discharge points and to identify any variations in flow direction or discharge that may occur throughout the study area over time.

3. Aquifer Pumping Tests

An aquifer pumping test(s) will be performed, if required, to determine the off-site hydraulic characteristics of the aquifer. Some of the hydraulic characteristics that would be investigated include the horizontal and vertical hydraulic conductivity, the anisotropy of the aquifer, and an evaluation of the local degree of fracture interconnection.

Several off-site pumping tests have been conducted immediately adjacent to and east of the landfill and south of the landfill in Maryland. On-site pumping tests will be conducted as part of the RD investigations for OU-1. The results of the previous pumping tests and the design and results (if available) of the OU-1 pumping test and the preliminary results of the OU-2 investigation will be reviewed and evaluated to determine if an additional off-site pumping test is required.

A Technical Memorandum will be issued if it is concluded that an additional aquifer testing and characterization is required to complete the off-site OU-2 investigation. This document will describe the purpose, scope, design, and planned analytical procedures in detail.

The current budget accounts for the review of existing data (and data to be generated in the near future in connection with OU-1 activities) to determine if a pumping test is necessary. Costs associated with the issuance of the Technical Memorandum and the conduct of the pumping test have not been included. In addition, a large-diameter pumping well and additional piezometers would potentially be necessary for this test due to the small (two-inch) diameter of the current and planned monitoring wells, the distance between the wells, and the relatively low permeabilities of the aquifer. These additional well installations have not been included in the current budget. A pumping test would also affect the cost for managing IDW. These additional costs have also not been included in the project budget.

4. Tracer Tests

An aquifer tracer test may be performed during the OU-2 investigation in order to establish the hydraulic interconnection between the landfill and the off-site aquifer, to determine the preferred direction(s) of groundwater flow, to estimate the distance that contaminants from the site have travelled, and to investigate the discharge relationships between the landfill and the off-site surface water bodies.

The need for or the feasibility of conducting a tracer test during the OU-2 investigation will be evaluated. Tracer tests generally are not suited to aquifers with low hydraulic conductivities and low groundwater velocities as have been determined in this area. The number of nearby domestic wells and the fact that these wells are the sole source of potable water within the immediate area will further complicate the performance of a tracer test because it severely reduces the number of tracers to be considered. In addition, many public health authorities restrict or prohibit the introduction of these chemicals into the aquifer.

Previous studies have attempted to use chlorides as a local groundwater tracer with inconclusive results. The previous RI measured several groundwater quality parameters, including chlorides (Cl), sulfates (SO_4), and others but did not tabulate these results or discuss them. These data will be reviewed to determine if there are any compounds introduced by the landfill and already in the aquifer that may serve as a tracer compound.

A Technical Memorandum will be issued if it is concluded that a tracer test is required to complete the off-site OU-2 investigation. This document will describe the purpose, scope, design, and planned analytical procedures in detail.

The current budget accounts for a determination of the feasibility of a tracer test, including an evaluation of potential tracer compounds, research of all applicable state and local laws governing the conduct of a tracer test, and a review and evaluation of the existing analytical data base to determine if any compounds already present in the aquifer (and attributable to the landfill) may serve as a tracer compound. The actual costs associated with the design, performance, and evaluation of a tracer test have not been included in the project budget.

4.3.5 Media Sampling

Media sampling to be performed during the field investigation is designed to characterize the nature and extent of contamination in the off-site areas surrounding the Keystone Landfill Site to assess risks to human health and the environment and to evalutate potential remedial action alternatives. The media to be sampled, the projected number of samples, and the required analyses are outlined in the following subsections. In general, the sampling program for OU-2 will include the following:

- Surface and subsurface soil sampling east of the former spray irrigation area to evaluate if airborne spray and/or surface runoff from the spray irrigation system have contaminated off-site soils. A soil gas survey will be conducted to identify any elelvated levels of hazardous substances in this area.

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- Surface soil sampling and subsurface soil sampling in the runoff "wash" area south of the landfill and Line Road to evaluate if contaminants are migrating off site via surface water runoff directly from the landfill or from the former spray irrigation area. Soil gas results will be used to identify any elevated levels of hazardous substances in this area.

- Surface soil sampling and subsurface soil sampling west of the landfill to evaluate if contaminants are migrating off site by surface water runoff or through wind action.

- Surface water and sediment sampling at approximately 30 locations along various unnamed tributaries surrounding the site to characterize any contaminant migration to these streams from on-site sources, soils, and/or groundwater and to evaluate risks to human or environmental receptors exposed to the surface waters and sediments.

- Surface water and sediment sampling at approximately five locations where significant runoff is observed to be leaving the perimeter of the landfill during heavy precipitation events to evaluate any off-site contaminant migration via this pathway.

- Groundwater sampling of 20 EPA RI monitoring wells, nine MDE monitoring wells, and approximately 18 new monitoring wells to determine the extent of off-site groundwater contamination.

- Groundwater sampling of approximatley 30 or more local residential wells to determine the lateral extent of groundwater contamination and to assess any risks to human health from using the water.

Media to be sampled for laboratory analyses include surface and subsurface soils, surface water and sediments, and groundwater. Specific media sampling requirements are described in the following paragraphs. See Soil Sample Location Map (Figure 4.4).

4.3.5.1 Surface Soil Sampling

Limited data currently exist regarding the nature and extent of off-site surface soil contamination. In order to determine the risks posed by surficial soils in the OU-2 study area, additional surface soil sampling is planned for the field investigation.

Up to five surface soil samples will be collected in the area east of the former spray irrigation area. The sample locations will be chosen after completion of the soil gas survey and will correspond with those areas

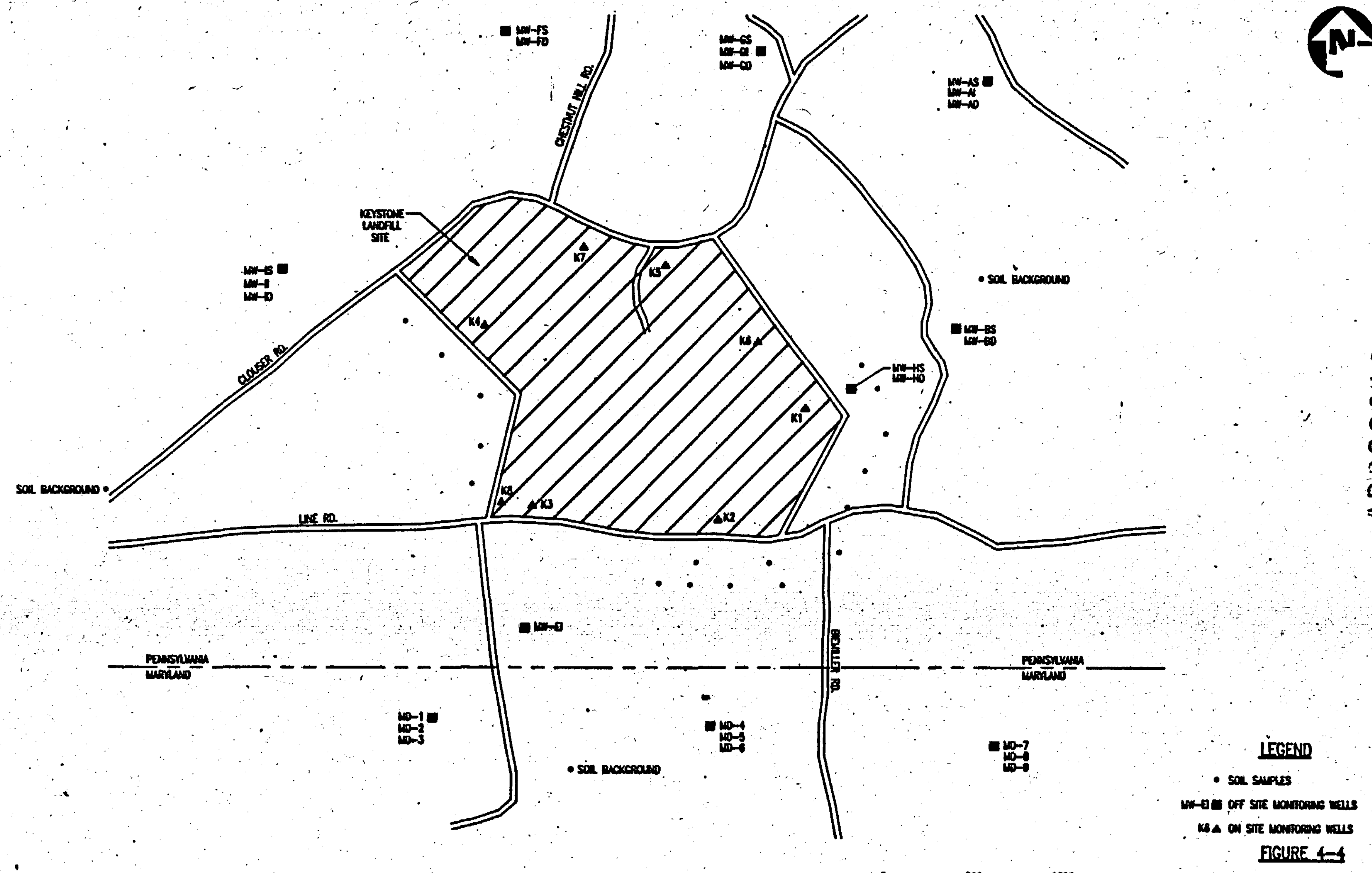

FIGURE 4-4

PROPOSED SOIL SAMPLE LOCATIONS
KEYSTONE LANDFILL

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that have the highest soil gas VOC concentrations. Although the soil gas samples will be obtained from a depth of about three feet, the assumed contaminant migration pathway to this area is by surface runoff or windborne spray of water pumped from on-site well K1. Therefore, analysis of surface soils in areas of elevated VOC concentrations in the soil gas survey is considered to be an important component to understanding the nature and extent of contamination in this area. If no VOC contamination is identified in the soil gas survey area, three random samples will be collected from this area for TAL/TCL analyses to assess the possible presence of other contaminants, as well as VOCs, in this area.

Up to seven surface soil samples will be collected from surface water runoff pathways or "wash" areas south of the landfill and Line Road. Four samples will be taken from the most prominent runoff pathways or from any areas of stained soils or stressed vegetation noted within the pathways. Up to three additional samples will be taken in areas where elevated VOC concentrations are noted during the soil gas survey results.

Up to five surface soil samples will be collected along the western perimeter of the landfill. These samples will be selected from drainage pathways or areas of stressed vegetation, staining, etc.

Three background soil samples will be collected in areas assumed to be outside the influence of the landfill. The sampling and analyses program for surface soil samples is presented in Table 4-2. All surface soil samples will be analyzed for the following parameters:

- Target Compound List (TCL) organics
- Target Analyte List (TAL) metals/cyanide
- Dichlorodifluoromethane
- Cation Exchange Capacity (CEC)
- Grain Size
- Moisture Content
- TOC
- TCLP

Up to six samples will be selected for TCLP analyses. The full complement of TCL/TAL parameters and dichlorodifluoromethane is necessary to determine if contamination of public or environmental health significance is present in the surface soils. The information provided by the other parameters listed in the preceding paragraph will be used, if necessary, in contaminant fate and transport analysis and evaluation of remedial alternatives.

TABLE 4-2
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM FOR SURFACE SOIL
KEYSTONE SANITATION LANDFILL SITE

Sample Description	Analytical Parameters	Analytical Methods	Analytical Option[1]	Data[2] Use	Number of Samples	Field Dups[3]	Trip Blank[4]	Rinsate Blank[5]	Field[6] Blank	MS/[7] MSD Lab[8] Dup
Surface Soil	TCL VOAs	CLP SOW (3/90)	Definitive	B,C,D	20	1	1	1	1	1
	TCL SVOAs PCB/Pest	CLP SOW (3/90)	Definitive	B,C,D	20	1		1	1	1
	TAL Metals Cyanide	CLP SOW (3/90)	Definitive	B,C,D	20	1		1	1	1
	TCLP TCL VOAs	CLP SOW (3/90)	Definitive	B,C,D	6	1	1	1	1	1
	TCLP TCL SVOAs	CLP SOW (3/90)	Definitive	B,C,D	6	1		1	1	1
	PCB/Pest		-							
	TCLP TAL Metals	CLP SOW (3/90)	Definitive	B,C,D	6	1		1	1	1
	Dichlorodifluoromethane	EPA 601	Definitive	B,C,D	20	1		1	1	1
Soil Characteristics	Lab Measurements									
	TOC	EPA 415/31	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Grain Size	ASTM	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Percent Moisture	CLP SOW	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	CEC		Screening	B,C,D	6	1	N/A	N/A	N/A	N/A

[1]Analytical options: defined as screening level data with definitive confirmation or definitive level data. Data Quality Objectives process for Superfund; Interim Guidance EPA, Washington D.C. EPA54-0R-93-071 September 1993.

[2]Data use options are defined as:
- A. Site characterization
- B. Risk assessment
- C. Evaluation of remedial alternatives
- D. Design of remedial alternatives

[3]Field Duplicates - A sample split in the field and submitted separately to the laboratory. The duplicate is analyzed for the same parameters as the first sample from the same sample location. This sample is collected to assess contamination from overall sample handling, preparation, and analysis.

[4]Trip Blank - Prepared from analyte- free water prior to sampling activities. The trip blank accompanies the samples at all times and is analyzed for volatile organic parameters only. The trip blank is prepared and analyzed at a rate of 1 per 20 environmental samples submitted for VOC analysis.

[5]Rinsate Blanks - Sample obtained by pouring analyte-free water over sampling equipment after decontamination. This sample is collected to assess decontamination procedures.

[6]Field Blank - Generated at the time of sampling by pouring analyte-free water into containers used to package environmental samples. This sample is collected to assess sample collection sample handling, preparation, and analysis techniques.

[7]MS/MSD - Samples prepared by the laboratory to evaluate sample preparation, handling, and analysis. These samples are analyzed at a rate of one per 20 environmental samples.

[8] ... Samples split by the laboratory to evaluate sample preparation, ha[illegible] and analysis. These samples are analyzed at a rate of one per 20 env[illegible]ental samples.

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4.3.5.2 Subsurface Soil Sampling

Very limited data exist regarding the nature and extent of off-site subsurface soil contamination. The primary purpose of the subsurface soil sampling is to confirm the results of the soil gas survey with a more thorough and detailed chemical analysis.

It is assumed that up to 17 subsurface soil samples will be collected using hand auger sampling techniques in locations east and south of the former spray irrigation area and along the western perimeter of the landfill. The locations will be the same as those of the surface soil sample locations, which were based on either field observations of physical conditions or areas of elevated VOC concentrations during the soil gas survey. The subsurface soil samples will be taken from the same depth as the soil gas samples for that area (approximately three feet). The three-foot depth is chosen in order to confirm positive results identified during VOC screening.

Three subsurface soil background samples will be collected at the same locations as the soil background samples. The sampling and analysis program for subsurface soil samples is presented in Table 4-3. All subsurface soil samples will be analyzed for TAC/TCL paramters and dichlorodifluoromethane. Up to six samples will be selected for soil characteristics analysis.

- TCL organic
- TAL metals/cyanide
- Dichlorodifluoromethane
- TCLP
- CEC
- Grain Size
- Moisture Content
- TOC

Up to six samples will be selected for soil characteristics analysis. The full complement of TCL/TAL parameters and dichlorodifluoromethane is necessary to determine if contaminant levels in the subsurface are a possible source of groundwater contamination detected in the OU-2 study area. The information provided by the other parameters listed in the preceding paragraph will be used, if necessary, in contaminant fate and transport analyses and evaluation of remedial technologies.

4.3.5.3 Surface Water/Sediment Sampling

Previous surface water and sediment sampling data do not conclusively indicate that stream quality and sediment conditions may be affected by contaminant migration from the site via either surface water

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TABLE 4-3
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
KEYSTONE SANITATION LANDFILL SITE

Sample Description	Analytical Parameters	Analytical Methods	Analytical Option[1]	Data[2] Use	Number of Samples	Field Dups[3]	Trip[4] Blank	Rinsate[5] Blank	Field[6] Blank	MS/[7] MSD Lab[8] Dup
Subsurface Soil	TCL VOAs	CLP SOW (3/90)	Definitive	B,C,D	20	1	1	1	1	1
	TCL SVOAs, PCB/Pest	CLP SOW (3/90)	Definitive	B,C	20	1		1	1	1
	TAL Metals, Cyanide	CLP SOW (3/90)	Definitive	B,C,D	20	1		1	1	1
	TCLP TCL VOAs	CLP SOW (3/90)	Definitive	B,C,D	6	1	1	1	1	1
	TCLP TCL SVOAs PCB/Pest	CLP SOW (3/90)	Definitive	B,C,D	6	1		1	1	1
	TCLP TAL Metals	CLP SOW (3/90)	Definitive	B,C,D	6	1		1	1	1
	Dichlorodifluoromethane	EPA 601	Definitive	B,C,D	20	1		1	1	1
Soil Characteristics	Lab Measurement		Screening							
	TOC	EPA 415.31	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Grain Size	ASTM	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Percent Moisture	CLP SOW	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	CEC		Screening	B,C,D	6	1	N/A	N/A	N/A	N/A

[1]Analytical options: defined as screening level data with definitive confirmation or definitive level data. Data Quality Objectives process for Superfund; Interim Guidance EPA, Washington D.C. EPA54-0R-93-071 September 1993.

[2]Data use options are defined as
A. Site characterization B. Risk assessment
C. Evaluation of remedial alternative D. Design of remedial alternatives

[3]Field Duplicates - A sample split in the field and submitted separately to the laboratory. The duplicate is analyzed for the same parameters as the first sample from the same sample location. This sample is collected to assess contamination from overall sample handling, preparation, and analysis.

[4]Trip Blank - Prepared from analyte-free water prior to sampling activities. The trip blank accompanies the samples at all times and is analyzed for volatile organic parameters only. The trip blank is prepared and analyzed at a rate of 1 per 20 environmental samples submitted for VOC analysis.

[5]Rinsate Blanks - Sample obtained by pouring analyte-free water over sampling equipment after decontamination. This sample is collected to assess decontamination procedures.

[6]Field Blank - Generated at the time of sampling by pouring analyte-free water into containers used to package environmental samples. This sample is collected to assess sample collection sample handling, preparation, and analysis techniques.

[7]MS/MSD - Samples prepared by the laboratory to evaluate sample preparation, handling, and analysis. These samples are analyzed at a rate of one per 20 environmental samples.

[8]Lab dup - Samples split by the laboratory to evaluate sample preparation, handling, and analysis. These samples are analyzed at a rate of one per 20 environmental samples.

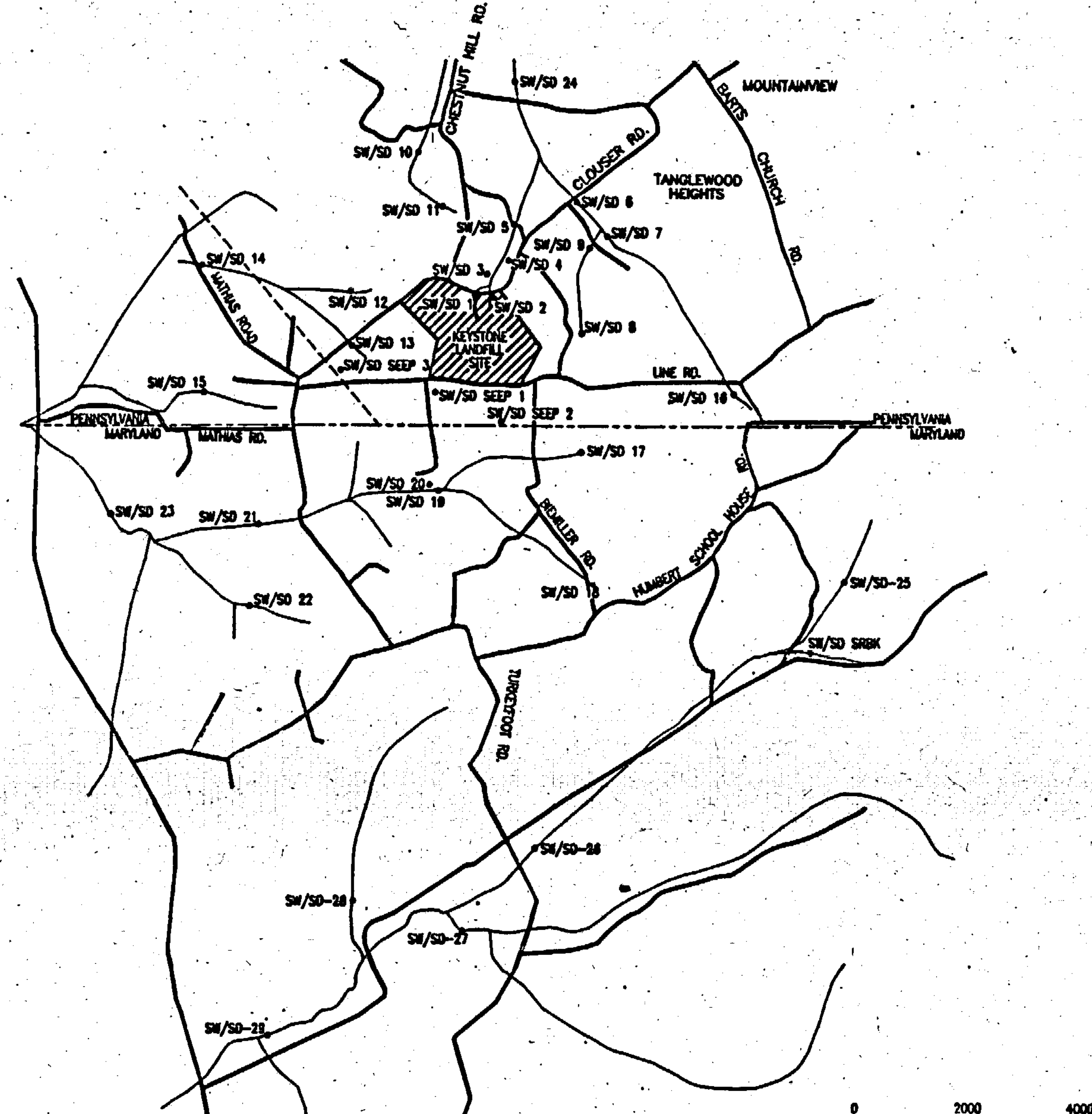
drainage pathways or groundwater discharge to surface water bodies. A comprehensive surface water and sediment investigation is proposed for the OU-2 RI/FS to determine the nature and extent of site-related contamination in the streams surrounding the site. Seeps and springs in the area will be sampled to evaluate the role of local groundwater flow and discharge to surface water as a contaminant migration pathway. Three rounds of surface water/sediment sampling will be used to evaluate seasonal variations in surface water and sediment quality. These three rounds of surface water and sediment sampling, in addition to a round of surface water and sediment sampling conducted in April by another EPA contractor, will be used to satisfy the requirement for quarterly sampling (four rounds) discussed in the OU-1 ROD. It is assumed that approximately 30 surface water and sediment samples will be obtained during each sampling event.

Tentative proposed surface water and sediment sampling locations are displayed on Figure 4.5. Final sampling locations will be chosen with EPA guidance upon review of the analytical results from previous sampling rounds. It is assumed that approximately 10 to 15 of the surface water and sediment sampling locations will possibly remain consistent throughout all sampling rounds in order to characterize any seasonal variations that may occur and/or to closely monitor any significant levels of contamination that may occur. The remaining surface water and sediment locations will be selected as necessary to obtain additional information based on the results of previous sampling rounds and with EPA guidance. The total number of sampling locations will remain about the same for each sampling round. Sample locations along Silver Run will be included during the second round of surface water/sediment sampling.

An additional round of surface water and sediment samples will be obtained at some point of the OU-2 RI/FS field work during a precipitation event. These opportunity samples will be obtained at a time when the amount and duration of precipitation have resulted in significant surface water runoff from the landfill to surrounding off-site areas. The samples will be obtained near the perimeter of the landfill to assess potential contaminant migration from the landfill to the OU-2 study area.

A reconnaissance of possible opportunity sample locations will be made during a precipitation event early in the course of the RI/FS field work. Samples will be collected and locations will be marked and described. If possible, the opportunity surface water and sediment samples will be collected during a precipitation event of sufficient duration that occurs when the ARCS III field team is present in the OU-2 study area. However, if necessary, a special trip will be made to the site during a rain event to collect samples.

It is assumed that no site access difficulties will be encountered and that enough precipitation events of adequate duration and intensity will occur when the ARCS III field team is present in the study area. It is also assumed that the laboratories performing the sample analyses will be able to adapt to the flexible



PROPOSED SURFACE WATER/SEDIMENT SAMPLES
KEYSTONE LANDFILL

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• SW/SD 10 – PROPOSED SAMPLING LOCATION

FIGURE 4–5

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schedule of the opportunity sampling. Approximately five surface water and five sediment samples will be collected during the sampling effort.

The sampling and analytical program for surface water and sediments samples is presented in Table 4-4. All surface water and sediments samples will be analyzed for the following parameters:

- TCL organics
- TAL metals and cyanide
- Methyl mercury
- Dichlorodifluoromethane

The following parameters are included in the analytical program for contaminant fate and transport analysis, environmental assessment purposes, or evaluation of remedial alternatives.

Surface Water		Sediments	
Field Measurement	Laboratory Measurement	Field Measurement	Laboratory Measurement
Temperature Dissolved Oxygen pH Conductivity Flow	TSS TDS Alkalinity Hardness Biolgocial Oxygen Demand (BOD) Color	Temperature Dissolved Oxygen pH Conductivity	TOC Grain Size Percent Moisture Percent Solids

4.3.5.4 Groundwater Sampling

Extensive groundwater sampling from both monitoring wells and residential wells has been performed at the site and within the OU-2 study area. However, the nature and extent of groundwater contamination attributable to the site have not been fully defined within the off-site areas. In order to address these concerns, several rounds of groundwater sampling, including new monitoring wells, existing off-site monitoring wells, and residential wells, are planned. Monitoring well sampling and residential well sampling will be described and performed as separate activities under this subtask.

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TABLE 4-4
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM FOR SURFACE WATER
KEYSTONE SANITATION LANDFILL SITE

Sample Description	Analytical Parameters	Analytical methods	Analytical Option	Data Use	Number of Samples	Field Dups	Trip Blank	Rinsate Blank	Field Blank	MS/MSD Lab Dup
Surface Water	TCL VOAs	CLP SOW (3/90)	Definitive	B,C,D	30	2	2	2	2	2
	TCL SVOAs PCB/Pest	CLP SOW (3/90)	Definitive	B,C,D	30	2		2	2	2
	TAL Metals Cyanide	CLP SOW (3/90)	Definitive	B,C,D	30	2		2	2	2
	Methyl Mercury	TBD	Definitive	B,C,D	30	2		2	2	2
	Dichlorodifluoromethane	EPA601	Definitive	B,C,D	30	2		2	2	2
Surface Water (Opportunity Samples)	TCL VOAs	CLP SOW (3/90)	Definitive	B,C,D	5	1	1	1	1	1
	TCL SVOAs PCB/Pest	CLP SOW (3/90)	Definitive	B,C,D	5	1		1	1	1
	TAL Metals, Cyanide	CLP SOW (3/90)	Definitive	B,C,D	5	1		1	1	1
	Methyl Mercury	TBD	Definitive	B,C,D	5	1		1	1	1
	Dichlorodifluoromethane	EPA 601	Def	B,C,D	30	2		2	2	2
Surface Water Pathway Characterization Parameters	Lab Measurement									
	Total Suspended Solids	EPA 160	Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	Total Dissolved Solids	EPA 160	Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	Alkalinity	EPA 310	Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	Hardness	EPA 130	Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	BOD	EPA 405.1	Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	Color	EPA 110	Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	Field Measurement		Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	Temperature		Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	DO		Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	pH		Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
	Conductivity		Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds

TABLE 4-4
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
KEYSTONE LANDFILL OU-2
RI/FS
PAGE 2 OF 2

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Sample Description	Analytical Parameters	Analytical methods	Analytical Option	Data Use	Number of Samples	Field Dups	Trip Blank	Rinsate Blank	Field Blank	MS/MSD Lab Dup
Surface Water Pathway Characterization Parameters (continued)	Flow		Screening	B,C,D	10 Samples x 3 rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds	1 x 3 Rounds
Sediment	TCLC VOAs	CLP SOW (3/90)	Definitive	C,B,D	30	2	2	2	2	2
	TCL SVOAs PCB/Pest	CLP SOW (3/90)	Definitive	C,B,D	30	2		2	2	2
	TAL Metals Cyanide	CLP SOW (3/90)	Definitive	C,B,D	30	2		2	2	2
	Methyl Mercury	TBD	Definitive	C,B,D	30	2		2	2	2
	Dichlorodifluoromethane	EPA-601	Definitive	C,B,D	30	2		2	2	2
Sediment (Opportunity Samples)	TCL VOAs	CLP SOW (3/90)	Definitive	C,B,D	5	1	1	1	1	1
	TCL SVOAs PCB/Pest	CLP SOW (3/90)	Definitive	C,B,D	5	1		1	1	1
	TAL Metals Cyanide	CLP SOW (3/90)	Definitive	C,B,D	5	1		1	1	1
	Methyl Mercury	TBD	Definitive	C,B,D	5	1		1	1	1
	Dichlorodifluoromethane	EPA 601	CBD	30	30	2		2	2	2
Surface Water Pathway Characterization Parameters (sediment analysis)	Lab Measurement									
	TOC	EPA 415.31	Screening	C,B,D	30	2	N/A	N/A	N/A	N/A
	Grain Size	ASTM	Screening	C,B,D	30	2	N/A	N/A	N/A	N/A
	% Moisture	CLP SOW	Screening	C,B,D	30	2	N/A	N/A	N/A	N/A
	% Solids	CLP SOW	Screening	C,B,D	30	2	N/A	N/A	N/A	N/A
	Field Measurement									
	Temperature		Screening	C,B,D	30	2	N/A	N/A	N/A	N/A
	Eh		Screening	C,B,D	30	2	N/A	N/A	N/A	N/A
	pH		Screening	C,B,D	30	2	N/A	N/A	N/A	N/A
	Conductivity		Screening	C,B,D	30	2	N/A	N/A	N/A	N/A

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Monitoring Well Sampling

Groundwater sampling from monitoring wells will include four rounds of samples from the existing off-site wells and two rounds of samples from wells installed during the OU-2 RI. The first round of monitoring well sampling was approved under an earlier letter work plan and therefore is not budgeted in this work plan. There are 29 existing monitoring wells to be sampled, including 20 wells installed during the first Keystone RI (well clusters A through I) and nine wells installed by MDE (wells MD-1 through MD-9 in Maryland). There will be approximately 18 new OU-2 RI/FS monitoring wells to be sampled. The locations of the existing and new (proposed) monitoring wells are shown in Figure 4.2.

Dedicated low-flow bladder pumps have been installed in the 29 existing monitoring wells, and it is assumed that the same, or similar, type of pumps will be installed in each of the new monitoring wells prior to sampling. It is also assumed that the two rounds of sampling from the new monitoring wells will be concurrent with the third and fourth rounds of sampling from the existing monitoring wells.

The sampling and analytical program for monitoring well groundwater samples is presented in Table 4-5. All groundwater samples will be analyzed for the following parameters:

- TCL organics (low detection limits)
- TAL metals (total and dissolved) and cyanide (low detection limits)
- Dichlorodifluoromethane

In addition, selected monitoring well samples will also be analyzed for the following parameters for use in evaluating remedial alternatives:

- Chemical Oxygen Demand
- TOC
- Alkalinity
- Ammonia
- BOD
- Chlorides
- Hardness
- Nitrates-Nitrates
- Sulfate
- TDS
- TSS

TABLE 4-5
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM FOR MONITORING WELLS
KEYSTONE SANITATION LANDFILL SITE

Sample Description	Analytical Parameters	Analytical Methods	Analytical Option[1]	Data[2] Use.	Number of[3] Samples	Field Dups[4]	Trip[5] Blank	Rinsate[6] Blank	Field[7] Blank	MS/[8] MSD Lab[9] Dup
Groundwater 29 MWs (old)	TCL VOAs	CLP SOW (3/90) low concentration method	Definitive	B,C,D	34	2	2	2	2	2
	TCL SVOAs	CLP SOW 3/90) low concentration method	Definitive	B,C,D	34	2		2	2	2
	PCB/Pest	CLP SOW (3/90) low concentration method	Definitive	B,C,D	34	2		2	2	2
	TAL Metals	CLP SOW (3/90) low concentration method	Definitive	B,C,D	34	2		2	2	2
	Dichlorodifluoromethane	EPA 601	Definitive	B,C,D	34	2		2	2	2
Groundwater 29 MWs (old) (Filtered)	TAL Metals (Dissolved)	CLP SOW (3/90) low concentration method	Definitive	B,C,D	34	2		2	2	2
	Chloride	EPA 325	Definitive	B,C,D	34	2		2	2	2
Groundwater Each sample round will include 15 MWs (old) 18 MWs (new) 5 Springs	TCL VOAs	CLP SOW (3/90) low concentration method	Definitive	B,C,D	38 samples x 2 rounds	2 x 2 rounds	2 x 2 rounds	2 x 2 rounds	2 x 2 rounds	2 x 2 rounds
	TCL SVOAs, PCB/Pest	CLP SOW (3/90) low concentration method	Definitive	B,C,D	38 samples x 2 rounds	2 x 2 rounds		2 x 2 rounds	2 x 2 rounds	2 x 2 rounds
	TAL Metals	CLP SOW (3/90) low concentration method	Definitive	B,C,D	38 samples x 2 rounds	2 x 2 rounds		2 x 2 rounds	2 x 2 rounds	2 x 2 rounds
Groundwater (Filtered)	TAL Metals (Dissolved)	CLP SOW (3/90) low concentration method	Definitive	B,C,D	38 samples x 2 rounds	2 x 2 rounds				
	Chloride	EPA 325	Definitive	B,C,D	38 samples x 2 rounds	2 x 2 rounds		2 x 2 rounds	2 x 2 rounds	2 x 2 rounds
	Dichlorodifluoromethane	EPA 601	Definitive	B,C,D	38 samples x 2 rounds	2 x 2 rounds		2 x 2 rounds	2 x 2 rounds	2 x 2 rounds

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TABLE 4-5
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
KEYSTONE LANDFILL OU-2
RI/FS
PAGE 2 OF 3

Sample Description	Analytical Parameters	Analytical Methods	Analytical Option[1]	Data[2] Use	Number of[3] Samples	Field Dups[4]	Trip[5] Blank	Rinsate[6] Blank	Field[7] Blank	MS/[8] MSD Lab[9] Dup
Groundwater Engineering Parameters	Chemical Oxygen Demand	EPA 410.4	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Alkalinity	EPA 310.2	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Ammonia	EPA 350	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Biological Oxygen Demand	EPA 405	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Chlorides	EPA 325	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Hardness	EPA 130.1	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Nitrate-Nitrates	EPA 353	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Sulfate	EPA 375.1	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Total Dissolved Solids	EPA 160	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Total Suspended Solids	EPA 160	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Field Measurements									
	pH	EPA 160	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Dissolved Oxygen	EPA 160	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Temperature	EPA 160	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A
	Conductivity	EPA 160	Screening	B,C,D	6	1	N/A	N/A	N/A	N/A

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[1]Analytical options: -	Defined as screening level data with definitive confirmation. Data Quality Objectives process for Superfund; Interim Guidance EPA, Washington D.C. EPA54-0R 93-071 September 1993.
[2]Data use options are defined as	A. Site characterization; B. Risk assessment; C. Evaluation of remedial alternative; D. Design of remedial alternatives
[3]Number of samples:	Represents 40 samples per round of sampling. Two rounds of groundwater samples are proposed. The first round of samples will include analysis of engineering parameters and filtered monitoring well samples for dissolved metals. After receipt of data for the first round, determination will be made as to the need for further analysis of dissolved metals and each engineering parameter.
[4]Field Duplicate-	Samples split in the field and submitted separately to the laboratory. The duplicate is analyzed for the same parameters as the first sample from the same location. This sample is collected to assess contamination from overall sample handling, preparation, and analysis.
[5]Trip Blank -	Prepared from analyte-free water prior to sampling activities. The trip blank accompanies the samples at all times and is analyzed for volatile organic parameters only. The trip blank is prepared and analyzed at a rate of 1 per 20 environmental samples submitted for VOC analysis.
[6]Rinsate Blanks -	Sample obtained by pouring analyte-free water over sampling equipment after decontamination. This sample is collected to assess decontamination procedures.
[7]Field Blank -	Generated at the time of sampling by pouring analyte-free water into containers used to package environmental samples. This sample is collected to assess sample collection sample handling, preparation, and analysis techniques.
[8]MS/MSD -	Samples prepared by the laboratory to evaluate sample preparation, handling, and analysis. These samples are analyzed at a rate of one per 20 environmental samples.
[9]Lab dup -	Samples split by the laboratory to evaluate sample preparation, handling, and analysis. These samples are analyzed at a rate of one per 20 environmental samples.
[10]Engineering Parameters -	Will be analyzed at selected sample locations during the first round of sample collection. These parameters will be elevated for remedial alternative selection.

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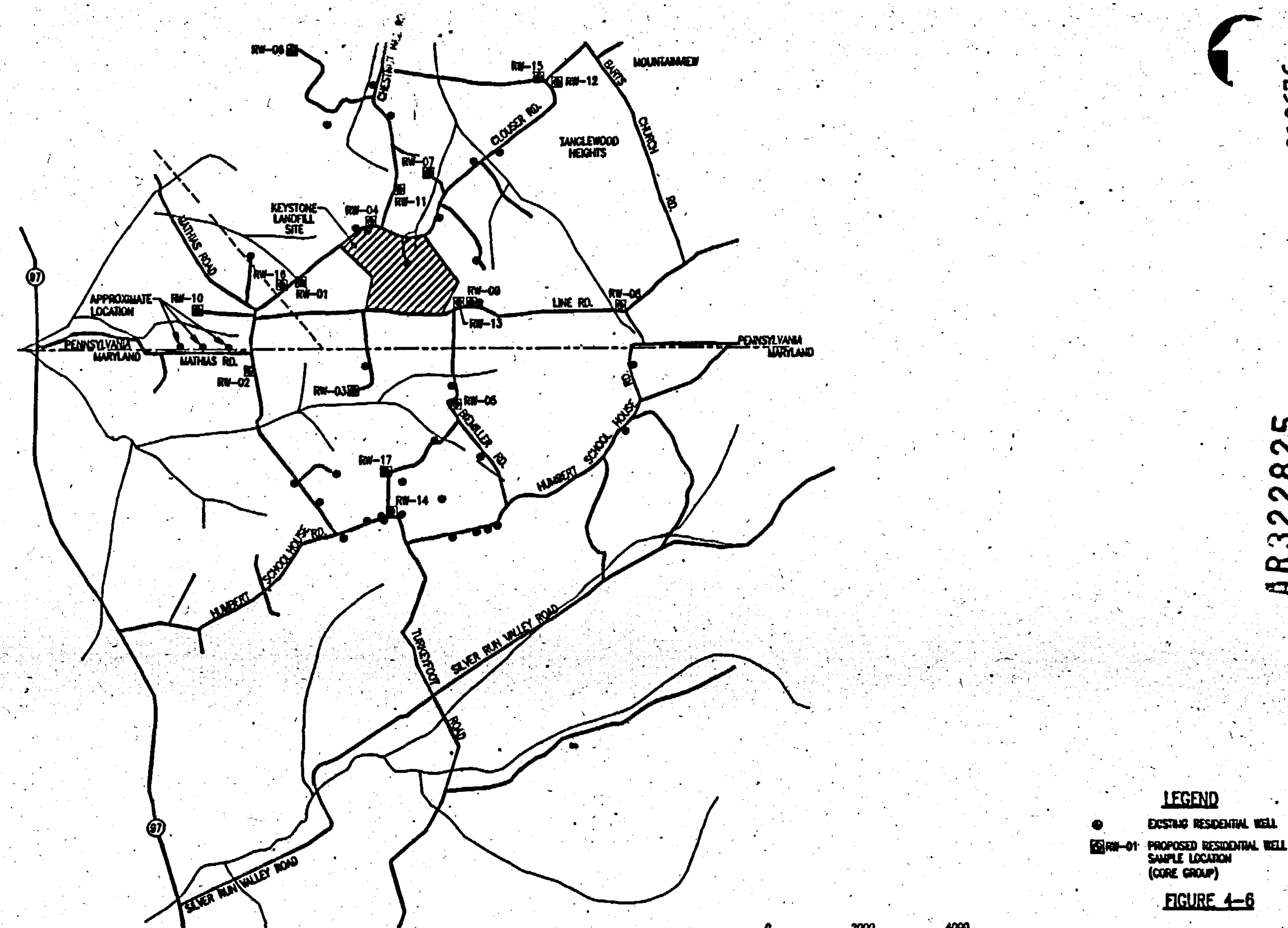
The full complement of TCL/TAL parameters is necessary to accurately characterize the occurrence and distribution of contamination in the groundwater and to evaluate the human health significance of the contamination. Analyses for all monitoring wells will be conducted using the Draft Superfund Analytical Methods for Low-Concentration Water, which provides low detection limits. This is required to ensure that the levels of the hazardous substance previously detected in the study area will be accurately defined.

Residential Well Sampling

Groundwater sampling from residential wells during the OU-2 RI will include two rounds of sampling from 30 wells. Two rounds of home well sampling were conducted in February 1994 and June 1994 and will be supplemented by the two rounds proposed in the OU-2 RI to account for one year of quarterly sampling. Data obtained during the first two rounds will be used to direct the remaining rounds of residential well sampling. A map showing the locations of available residential wells for sampling is shown in Figure 4.6. Several recently completed residential wells in the OU-2 study area may be added to the list of wells considered for sampling based upon their location and availability. Final residential well sampling locations will be chosen with EPA guidance before each round of sampling based on the analytical results from previous residential well sampling rounds.

Approximately 10 to 15 of the residential well sampling locations will remain consistent throughout all the sampling rounds to closely monitor areas where the most significant or persistent levels of hazardous substances attributable to the site have occurred. The remaining residential well sampling locations will be selected as necessary, with EPA guidance, to obtain additional information based on the results of previous sampling rounds. It is anticipated that the total number of residential well sample locations will remain the about the same for each sampling round. If previously unsampled residential wells are to be sampled, the owner will be asked to provide available details such as well depth, construction materials, screened or open interval, and water usage.

Approximately 10 to 15 of the residential well sampling locations will remain consistent throughout all the sampling rounds to closely monitor areas where the most significant or persistent levels of hazardous substances attributable to the site have occurred. The remaining residential well sampling locations will be selected as necessary, with EPA guidance, to obtain additional information based on the results of previous sampling rounds. It is anticipated that the total number of residential well sample locations will remain the about the same for each sampling round. If previously unsampled residential wells are to be sampled, the owner will be asked to provide available details such as well depth, construction materials, screened or open interval, and water usage.



PROPOSED RESIDENTIAL WELL SAMPLING
KEYSTONE LANDFILL

FIGURE 4-6

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Residential well samples will be taken as close to the well head as possible and prior to any filtration or treatment systems. The sampling and analytical program for residential well samples is presented in Table 4-6. All residential well samples will be analyzed for the following parameters:

- TCL organics (low detection limits)
- TAL metals/cyanide (total and dissolved low detection limits)
- Chlorides
- Dichlorodifluoromethane

The full complement of TCL/TAL parameters is necessary to accurately characterize the occurrence and distribution of contamination in the groundwater and to evaluate the human health significance of the contamination. All analyses (except chlorides) for all residential wells will be conducted using the Draft Superfund Analytical Methods for Low-Concentration Water, which provides low detection limits. This is required to ensure that the levels of the hazardous substances previously detected in the study area will be accurately defined.

4.3.6 Ecological Assessment

An ecological assessment of the Keystone Sanitation Landfill Site area will be performed during the OU-2 RI. The purpose of the ecological assessment is to provide a qualitative or quantitative appraisal of the actual or potential effects of hazardous substances attributable to the site on plants and animals. The study area (Figure 4.7) for this assessment will be determined based on surface water and sediment sample locations, along with a reconnaissance of the site environs. The updated assessment will build upon existing information and the results of the OU-1 RI. Four tasks will be performed as part of the initial assessment:

- Conduct an updated literature review to identify ecological and other sensitive environments within the study area.

- Characterize vegetation within the study area.

- Identify and delineate the approximate boundaries of wetlands identified within the study area.

- Characterize plants and animals associated with any wetlands located along, or adjacent to, springs and surface water bodies within the study area.

TABLE 4-6
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM FOR RESIDENTIAL WELLS
KEYSTONE SANITATION LANDFILL SITE

Sample Description	Analytical Parameters	Analytical methods	Analytical Option[1]	Data Use[2]	Number of Samples[3]	Field Dups[4]	Trip[5] Blank	Rinsate Blank[6]	Field Blank[7]	MS[8] MSD LAB[9] DUP
Ground Water Residential wells	TCL VOAs	CLP SOW, (3/90) Low Concentration method	Definitive	B,C,D	30 samples x 2 rounds	3	3	3	3	3
	TCL SVOAs PCB/Pest	CLP SOW (3/90) Low concentration method	Definitive	B,C,D	30 samples x 2 rounds	3		3	3	3
	TAL Metals	CLP SOW (3/90) Low concentration	Definitive	B,C,D	30 samples x 2 rounds	3		3	3	3
	Chlorides	EPA 325	Definitive	B,C,D	30 samples x 2 rounds	3		3	3	3
	Dichlorodifluoromethane	EPA 601	Definitive	B,C,D	30 samples x 2 rounds	3		3	3	3

[1]Analytical options: Defined as screening level data with definitive confirmation, or definitive level data. Data Quality Objectives process for Superfund; Interim Guidance EPA, Washington D.C. EPA54-0R 93-071 September 1993.

[2]Data use options are defined as
A. Site characterization
B. Risk assessment
C. Evaluation of remedial alternative
D. Design of remedial alternatives

[3]Number of samples: represents 40 samples per round of sampling. Two rounds of groundwater samples are proposed. The first round of samples will include analysis of engineering parameters and filtered monitoring well samples for dissolved metals. After receipt of data for the first round, determination will be made as to the need for further analysis of dissolved metals and each engineering parameter.

[4]Field Duplicate- Samples split in the field and submitted separately to the laboratory. The duplicate is analyzed for the same parameters as the first sample from the same location. This sample is collected to assess contamination from overall sample handling, preparation, and analysis.

[5]Trip Blank - Prepared from analyte-free water prior to sampling activities. The trip blank accompanies the samples at all times and is analyzed for volatile organic parameters only. The trip blank is prepared and analyzed at a rate of 1 per 20 environmental samples submitted for VOC analysis.

te Blanks - Sample obtained by pouring analyte-free water over sampling equipment after decontamination. This sample is collected to assess decontamination procedures.

Blank - Generated at the time of sampling by pouring analyte-free water into containers used to package environmental samples. This sample is collected to assess sample collection sample handling, preparation, and analysis techniques.

/MSD - Samples prepared by the laboratory to evaluate sample preparation, handling, and analysis. These samples are analyzed at a rate of one per 20 environmental samples.

b dup - Samples split by the laboratory to evaluate sample preparation, handling, and analysis. These samples are analyzed at a rate of one per 20 environmental samples.

Engineering Parameters - Will be analyzed at selected sample locations during the first round of sample collection. These parameters will be elvaluated for remedial alternative selection.

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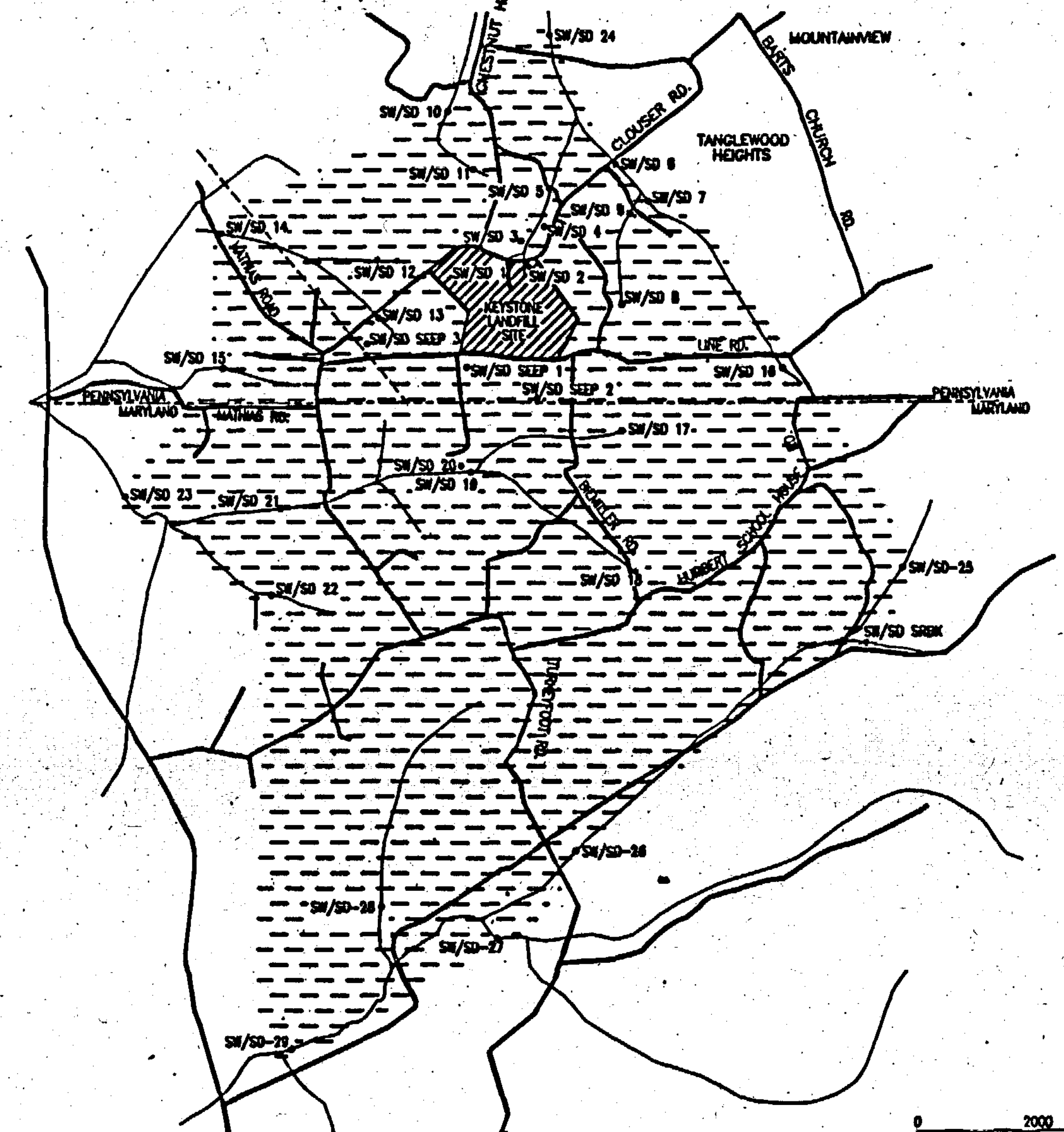

LEGEND

• SW/SD 10 – PROPOSED SAMPLING LOCATION

STUDY AREA FOR ECOLOGICAL ASSESSMENT

FIGURE 4–7

STUDY AREA FOR ECOLOGICAL ASSESSMENT
KEYSTONE LANDFILL

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A literature review will be conducted to identify habitats and streams, delineate wetlands, and identify potential ecological receptors most likely to be exposed to hazardous substances attributable to the site. Both aquatic and terrestrial receptors will be examined. The literature review will also determine if endangered, threatened, or otherwise protected species are present in the vicinity of the study area. To date, these types of species have not been identified in the vicinity of the site. Appropriate federal, state (e.g., State Game Commission, State Bureau of Forestry), and local environmental and wildlife management agencies will be contacted to determine if these species may exist in the area.

The vegetation characterization will be performed during the growing season to the extent practicable. A field survey will be conducted of the flora and fauna within the study area to identify any potential impacts related to the site. The results of the survey will be compared with existing information describing the common flora and fauna for the study area, as well as with information generated during the OU-1 RI/FS. The survey will include observations of plant life for potentially adverse effects attributable to the site.

The purpose of the wetlands assessment is to provide a qualitative appraisal of the actual or potential effects of hazardous substances attributable to the site on plants and animals associated with wetlands in the study area, including the effects of any discharges of groundwater to nearby springs and surface water bodies. Several marshy areas are present around these features, and some have been classified as wetlands.

The wetlands assessment will be performed during the growing season to the extent practicable and will include a determination of the dominant plant species, an evaluation of soils along the wetland boundaries, and an evaluation of the surface water hydrology. A field survey will be conducted to identify and delineate wetland boundaries along nearby springs and surface water bodies within the study area. If necessary, the survey area will be expanded in the event that wetlands are found at the limits of the study area.

Wetland boundaries will be marked on site maps but will not be surveyed. The wetland identification will be conducted in accordance with the methodology presented in the Federal Manual for the Identification and Delineation of Jurisdictional Wetlands (EPA, 1989). Wetlands will be classified using the United States Fish and Wildlife Service National Wetlands Inventory (NWI) procedures found in the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, Carter, Golet, and LaRoe, 1979). The functions and values of any identified wetlands will be based on observations during the field survey. If necessary, functions and values will be assessed using the Wetland Evaluation Technique (WET); Volume II: Methodology (Adamus, Clairain, Smith, and Young, 1987); however, this assessment is not part of the current project budget. The results of the wetlands assessment will be compared with existing information describing the common flora and fauna for the area, as well as with information generated during previous investigations and studies.

The results and findings of the initial ecological assessment will be summarized in the OU-2 RI report as appropriate. A screening-level ecological risk assessment will be carried out based on these results and findings. A conservative approach will be used to evaluate ecological risk-levels that protect the greatest number of species. This approach involves calculating an environmental effects quotient (EEQ) based on ambient water quality criteria (or other appropriate criteria) and hazardous substance concentrations for chemicals of concern associated with the site.

If the media sampling results (i.e., based on surface water and sediment samples collected during the OU-2 RI field work) and the results of the screening-level ecological risk assessment indicate that a more in-depth ecological assessment is warranted, an expanded ecological assessment within the study area will be performed. Before developing a detailed scope of work for this assessment, a literature review of the ecological chemicals of concern will be conducted to assess toxicological properties, ecological exposure routes (e.g., direct ingestion, percutaneous absorption, respiration, and direct contact of contaminated soils and water), and potential effects on both aquatic and terrestrial receptors. Ecological receptors will be selected from representative populations considered to be exposed in the habitats and media within the study area, as well as from pathways of likely contaminant transport. The extent of actual or potential ecological contamination will also be delineated during the scoping of the expanded assessment.

The scoping of the expanded ecological assessment may indicate that additional investigation and characterization of ecological impacts are not warranted. However, an expanded assessment will be performed upon EPA approval of the additional scope of work and funding. Expanded ecological assessment activities may include

- Collect additional surface water and sediment samples from nearby surface water bodies and springs within or outside the original study area.

- Collect samples from local plants, aquatic organisms, and terrestrial receptors within or outside the original study area.

- Perform macroinvertebrate and fish surveys using EPA's Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish, dated May 1989.

- Conduct other special studies such as chronic toxicity testing, fish tissue analyses, computer modeling of ecological fate and transport processes, and habitat studies.

If such activities are performed, the results and findings will be incorporated into the OU-2 RI report as appropriate. The current project budget estimate does not include costs for the expanded ecological assessment; however, it does include costs associated with scoping this assessment.

4.3.7 Site Survey

The surveying services required for the OU-2 RI will be subcontracted and will consist of the following tasks:

- Survey the horizontal location and vertical elevation of the ground surface, the uncapped well riser, and the top of the protective casing of each of the 18 monitoring wells to be installed during this investigation, the 20 existing monitoring wells installed during the RI, and the nine existing monitoring wells installed by MDE.

- Survey the horizontal location and vertical elevation of the ground surface, the uncapped well riser, and the top of the protective casing of each of the eight existing site monitoring wells (K1 though K8) and all off-site monitoring wells and piezometers located during the monitoring well and piezometer inventory (approximately 30 to 40 points, estimated).

- Survey the horizontal location and vertical elevation of the ground surface at the corner and major bends along the new fence surrounding the landfill (approximately 12 points, estimated) so that the fence can be accurately plotted on maps and used as a reference for the soil gas and soil sample locations.

- Survey the horizontal location and vertical elevation of the ground surface nearest to the discharge point and the water level of all springs and seeps sampled or noted during the field investigation (approximately eight points, estimated).

- Survey the horizontal location and vertical elevation of approximately five staff gauges installed during this investigation at road crossings, major confluences, and headwaters of local streams surrounding the site.

- Survey measurements will be made relative to U.S.G.S. MSL elevation, Pennsylvania State, and State of Maryland Plane Coordinates.

The field team will install the staff gauges, mark or flag all survey locations for which this is necessary and provide maps of the approximate survey locations to the subcontractor. The field team members will also provide health and safety training to the subcontractor, show or direct the subcontractor to all survey locations, and provide the necessary oversight for this subtask. It is assumed that site access to all survey locations will be obtained without difficulty.

4.3.8 RI Waste Disposal

OU-2 RI field activities will generate wastes that may or may not be contaminated with hazardous substances. These wastes could include drill cuttings, used protective clothing and equipment (gloves, boot covers, Tyvek coveralls, and sample scoops), groundwater from well development, purging, or pumping tests, and water used for equipment or personal decontamination. It is assumed that some or all of these materials will have to be collected, containerized, and staged in a designated area pending proper disposal.

All contaminated liquid wastes generated during RI activities will be containerized for proper disposal at an approved facility. To the extent practicable, contaminated liquid wastes will be disposed at a publicly owned treatment works facility. Drill cuttings will either be spread on the ground at the well location from where they were generated or at another approved location or will be containerized for disposal at ar approved facility.

Whenever IDW are to be disposed at an approved facility, a subcontract for this activity will be procured as discussed in Section 4.3.1.5.

4.4 TASK 4 - SAMPLE ANALYSIS AND DATA VALIDATION

The FSP and the QAPP will be developed as part of the SAP for the OU-2 RI. The FSP will contain guidance for all field activities, sampling operations, and sample handling. The QAPP will discuss quality assurance objectives, laboratory sample custody, instrument calibrative procedures, analytical procedure, and data processing.

4.4.1 Field Analysis

Data collection planned during field activities includes screening analysis on a variety of media. Proposed sample analysis and sample QA/QC requirements are presented in the tables following each medium in Section 4.3.5 of this work plan.

Samples will be collected in accordance will HNUS SOPs (Appendix A Keystone FSP) to ensure the integrity and representativeness of the samples.

Soil Gas Survey

In the case of collection of soil gas samples, the subcontractor will collect samples under the direct supervision of the HNUS site manager in accordance with an approved technical scope of work. In the event a mobile field laboratory is utilized to conduct the analyses, the subcontractor will provide appropriate quality assurance documentation as specified in the technical requirements of the subcontract. This documentation will include but is not limited to historical instrument records, calibration records, analytical run logs, analytical standard preparation logs, and initial analytical results.

EPA-approved method EPA 601 (modified) will be requested for analysis of selected VOCs. Table 4-6 provides a detailed overview of the number of samples and analytical requirements for the soil gas survey data set. Quality assurance/quality control (QA/QC) samples will be analyzed at a rate of one per 20. These samples will include sample duplicates and prepurified nitrogen or ambient air. An equipment purge sample will be collected after equipment purge decontamination at a rate of one per 40 samples.

Methane Survey

Samples analyzed for methane will require direct injection and will provide a chromatograph. Data will be collected to establish a concentration contour map. Approximately 180 samples will be collected. Table 4-1 presents sample specific analytical requirements. Refer to Figure 4.1 for specific sample locations.

Analytical information collected during field activities will be collected in accordance with HNUS SOPs, the approved technical scope of work for the subcontractor, and manufacturers' instructions.

4.4.2 Laboratory Analysis

Samples collected for laboratory analysis will be submitted under the EPA Contract Laboratory Program.

Several samples will require non-Routine Analytical Services (RAS). Due to changes in EPA procurement strategies for Special Analytical Services (SAS), it is expected that all samples other than those submitted under RAS will be submitted under the new procurement program, Delivery of Analytical Services (DAS). DAS will maintain the requirement for Contract Laboratory Program (CLP) certification and all other CLP program requirements; the major change in the new program is the method of procurement of services.

TAL/TCL for surface water/sediment and soil samples will be submitted for organic analysis under the EPA CLP RAS program. Analysis will be conducted using the most recent revisions to the CLP statement of work. Total numbers of each type (RAS or DAS) of sample submission are provided in the QAPP sectoin of the SAP.

4.4.3 Quality Control and Data Validation

Quality control mechanisms will be implemented in the field and in the laboratory. Monitoring functions include but are not limited to calibration of field instrumentation, appropriate documentation, collection and/or generation of quality control samples, and data validation.

The project manager is responsible for ensuring that the field team members are trained in the calibration, use, and maintenance of all applicable field instruments and equipment.

Field instruments will be inspected at the beginning of each day to ensure that the equipment is properly calibrated and in operable condition. Equipment will be calibrated in accordance with HNUS SOPs and manufacturers' instructions (SAP Appendix A). Calibration information will be recorded on the Equipment Calibration Logsheet (SAP Appendix B). Field instruments in need of repair will be removed from service and clearly marked to ensure against further use.

The field logbooks will clearly identify the specific instruments used for each task.

Field data will be reviewed and evaluated by the project manager for completeness and accuracy throughout the duration of field activities. Changes in sample collection activities or requirements will be recorded in the site-specific logbook and a task modification will be forwarded to the project and program managers. Specific sample collection requirements are presented in the Keystone Landfill RI/FS FSP.

The laboratories are responsible for properly calibrating and maintaining analytical equipment in accordance with EPA CLP requirements. The laboratory's approved QA plan and specific method requirements must be in accordance with the most recent CLP analytical statement of work. Sufficient documentation of compliance will be provided by the laboratory and will be included in the data package.

Analytical services requested will be in accordance with EPA QC levels, described as screening level data with definitive confirmation and definitive data (see below). The requirements for each of the two categories are defined in Data Quality Objectives Process for Superfund; Interim Final Guidance; September 199? (EPA540-R-93-071).

Screening Data QA/QC Elements

- Sample documentation (location, date and time collected, batch, etc.).
- Chain of custody (when appropriate).
- Sampling design approach (systematic, simple or stratified random, judgmental, etc.).
- Initial and continuing calibration.
- Determination and documentation of detection limits.
- Analyte(s) identification.
- Analyte(s) quantification.
- Analytical error determination - An appropriate number of replicate aliquots, as specified in the QAPP, are taken from at least one thoroughly homogenized sample, the replicate aliquots are analyzed, and standard laboratory QC parameters (such as variance, mean, and coefficient of variation) are calculated and compared to method-specific performance requirements specified in the QAPP.
- Definitive confirmation - at least 10 percent of the screening data must be confirmed with definitive data as described below. As a minimum, at least three screening samples reported above the action level [or as non-detects (ND)] should be randomly selected from the appropriate group and confirmed.

Definitive Data QA/QC Elements

- Sample documentation (location, date and time collected, batch, etc.).
- Chain of custody (when appropriate).
- Sampling design approach (systematic, simple or stratified random, judgmental, etc.).
- Initial and continuing calibration.

- Determination and documentation of detection limit.
- Analyte(s) identification.
- Analyte(s) quantification.
- QC blanks (trip, method, rinsate).
- Matrix spike recoveries.
- Performance evaluation (PE) samples (when specified).
- Analytical error determination (measures precision of analytical method) - An appropriate number of replicate aliquots, as specified in the QAPP, are taken from a least one thoroughly homogenized sample, the replicate aliquots are analyzed, and standard laboratory QC parameters (such as variance, mean, and coefficient of variation) are calculated and compared to method-specific performance requirements defined in the QAPP.
- Total measurement error determination (measures overall precision of measurement system from sample acquisition through analysis) - An appropriate number of co-located samples as determined by the QAPP are independently collected from the same location and analyzed following standard operating procedures. Based on these analytical results, standard laboratory QC parameters such as variance, mean, and coefficient of variation should be calculated and compared to established measurement error goals. This procedure may be required for each matrix under investigation and may be repeated for a given matrix at more than one location at the site.

For analytical data packages generated as definitive quality, the laboratories will be required to provide full data packages with complete QA/QC documentation.

It is planned that the data will be validated using EPA full national functional guidelines (IM-2 for inorganics and M3 for organics.) Use of IM-2 and M-3 procedures will ensure a comprehensive assessment of data quality, suitable for all data uses. IM-2 data validation consists of a complete technical review of the inorganics data package according to requirements defined in the April 1993 revision of the Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses. M-3 data validation consists of a complete technical review of the organics data package according to the June 1992 revision of the Region III Modifications to National Functional Guidelines for Organic Data

Review. Unlike lower-tier data validation levels, IM-2 and M-3 include review of raw data for both detected and non-detected sample results and raw data review for QA/QC data, and deliverables include a data summary, narrative report, and detailed support documentation.

Data Validation

In all cases where definitive data are being obtained, data reduction will be performed by the laboratory in accordance with the laboratory's CLP certification and laboratory SOPs. Documentation to support the data review will be included in the data package.

Samples submitted under the CLP RAS program will receive full data validation by EPA using the most current EPA functional guidelines. The validation programs are designated as 1M-2 for inorganics and M-3 for organics.

Samples requiring definitive level data and special analytical services under the DAS program analyzed by EPA Central Regional Laboratory (CRL) will also be validated using the full functional guidelines (1M-2, M-3 programs). Samples submitted under DAS but subcontracted to a non-CLP laboratory for analysis will be validated by HNUS also using full functional guidelines.

Analyses performed as screening level data will be reduced and evaluated by HNUS according to method requirements.

Tables summarize the sampling and analysis program presented in Section 4 provide a designation for data quality category.

4.5 TASK 5 - DATA EVALUATION

Data evaluation will be initiated upon receipt of validated data. Data will be compared to the project objectives and summarized into a usable format for data manipulation. Tables will be created to exhibit data, contaminant concentrations will be plotted on site maps, and groundwater contour maps will be developed. Contaminant receptors will be identified, contaminant migration routes defined, and contaminant migration models will be calibrated. The results of this task will be used in the risk assessment (Task 6) and in the evaluation of remedial alternatives (Tasks 9 and 10) and will be presented in the RI report (Task 8).

The specific aspects of data evaluation are summarized below:

- Evaluate groundwater analytical data
- Evaluate surface water and sediment data
- Evaluate soil data
- Evaluate hydrogeologic data
  - Prepare potentiometric surface maps
  - Evaluate aquifer testing results
  - Calculate groundwater flow parameters
  - Evaluate geologic cross-sections

This task will also include an assessment of whether additional investigation is required for the full definition of the groundwater, surface water and sediments, and/or soil contamination. Also, the need for further ecological studies will be evaluated. Following a preliminary assessment of the field investigation findings, a meeting will be held among EPA Region III, HNUS, and other interested parties. If it is determined that additional field investigation is required, a Technical Direction Memorandum (TDM) will be prepared. The TDM will be used to document the completion of the OU-2 RI/FS and will provide a mechanism for changing the authorized ceiling with respect to the funding level for the work assignment (if necessary). Accompanying the TDM will be a revision to the work plan documenting the scoping, scheduling, and budgeting requirements of the proposed work.

4.6 TASK 6 - RISK ASSESSMENT

This task includes all work efforts related to conducting the human health and environmental risk assessment. The risk assessment will follow current EPA guidance. After data collection, validation, and preliminary evaluation have been completed, a letter will be prepared to describe in detail the approach to be followed in risk assessment. Because the risk assessment will be based upon the analytical data from a dynamic sampling plan and associated findings regarding detected hazardous substances attributable to the site, complete details of the approach (e.g., number of chemicals of concern, groundwater wells evaluated, areas of separate influence, etc.) will depend on the outcome of the sampling investigation.

The risk assessment will include the following tasks:

- Data evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Environmental assessment

Special risk assessment concerns such as Acquired Toxic Exposure Syndrome (ATES) and Multiple Chemical Sensitivity Analysis (MCSA) are not included in the technical scope of work for this project.

The data evaluation task is primarily concerned with selecting chemicals of concern that are site related and whose data are of sufficient quality for use in a quantitative risk assessment. Contaminant concentrations will be compared to site-specific background concentrations and/or naturally occurring or anthropogenic levels to eliminate those chemicals that are not present at elevated concentrations.

The end result of this step is a list of chemicals for each matrix analyzed. Based on the existing data from the OU-1 RI report, it is expected that a number of VOCs will be retained as chemicals of concern. Other compounds that were previously identified on site and used as chemicals of concern during the OU-1 RI may be retained in the list, if detected at off-site locations during the OU-2 investigation.

A representative concentration will be estimated for each chemical of concern in each matrix. Current exposure risks will be evaluated separately from future exposure risks. For an individual well, assessment of current exposure and human health risks will be based upon a reasonable maximum exposure (RME) assumption using the highest of OU-2 RI validated sampling results for that well. To estimate maximum potential future exposure from household use of contaminated groundwater, an upper 95 percent confidence limit for the concentration of each chemical of concern in groundwater will be computed for each off-site groundwater well group, as defined by hydrogeological characteristics and sampling results. For all matrices, an upper 95 percent confidence interval will be calculated to develop an RME. Note that calculation of these statistics will be preceded by careful evaluation of specific data points subject to regional risk assessment procedures (for example, treatment of duplicates, non-detects, and qualified data) and evaluation of the distributional shape of each type of chemical analytical data (e.g., normal or lognormal).

An exposure assessment estimates the type and magnitude of exposures to the chemicals of concern. The first step is to characterize the exposure setting with respect to physical site characteristics and the population characteristics. The second step is to identify the pathways by which the population can be exposed. Each pathway is identified based on consideration of sources, releases, types, and locations of chemicals present at the site, the fate of these chemicals, and the activities of the local population. Points of contact and routes of exposure (e.g., dermal contact, ingestion, and/or inhalation) are also identified. Finally, the estimated representative contaminant concentrations will be used to calculate chemical intakes.

Potential exposures that may be considered at this site are the following:

- Ingestion of contaminated groundwater, dermal contact with contaminated groundwater while bathing and inhalation of contaminants found in the groundwater while showering.

- Off-site dermal contact with surficial soils and incidental ingestion of off-site soil.

- Inhalation of contaminants volatilizing from off-site contaminated soil by off-site human receptors.

- Ingestion of dermal contact with surface waters/sediments of springs and creeks potentially contaminated by groundwater discharges to the surface waters or by surface water runoff from the site. Ingestion of fish taken from creeks or springs in the vicinity/downstream of the site.

- Ingestion of contaminated agricultural crops or livestock meat and/or milk raised in areas contaminated by the site, where significant bio-uptake might have occurred.

The toxicity assessment presents a summary of available information on the toxicity and/or carcinogenicity of each chemical of concern. Most of this dose-response data are available from various EPA and Agency for Toxic Substances and Disease Registry (ATSDR) sources for the known chemicals of concern. The current dose-response parameters necessary for the completion of a quantitative risk assessment (e.g RfDs, Cancer Slope Factors, and weight of evidence of carcinogenicity) will be compiled from sources such as the Integrated Risk Information System and the quarterly Health Effects Assessment Summary Tables.

The risk characterization integrates the results of the toxicity and exposure assessments into quantitative and qualitative estimates of risk. Estimated intakes are compared to RfDs when characterizing noncarcinogenic risks. Individual and/or population probabilities of developing cancer are estimated from the intakes and the Cancer Slope Factors. All assumptions will be clearly presented, as well as an estimate of the uncertainties in the risk assessment process.

Upon completion of the risk assessment, HNUS will develop risk-based action levels for each exposure scenario evaluated. These action levels will be used to determine the areas and volumes to be remediated for each medium (e.g., groundwater and soil). Areas where contaminant concentrations are below the action levels will not require remediation.

An ecological risk assessment of the Keystone Sanitation Landfill Site area will also be performed during the OU-2 RI and will provide a qualitative or quantitative appraisal of the actual or potential effects of hazardous substances attributable to the site on plants and animals, including crops and livestock, wher appropriate. The updated assessment will build upon existing information and the results of the OU-1

RI/FS. Based upon the results and findings of the initial ecological investigation, a screening-level ecological risk assessment will be carried out using a conservative approach to evaluate risk levels that protect the greatest number of species. The results and findings of the initial ecological assessment will be summarized in the OU-2 RI report as appropriate. If media sampling results (i.e., surface water and sediment data from the OU-2 investigation) and the results of the screening-level assessment indicate that a more in-depth ecological assessment is warranted, an expanded ecological investigation and risk assessment will be performed upon EPA approval of the additional scope of work and funding.

The ecological risk assessment will consist of five primary components: (1) physical and biological descriptions of the study area, (2) selection of chemicals of concern, (3) exposure assessment, (4) hazard assessment, and (5) risk characterization. The biological description briefly describes the major plant and animal species observed or expected to inhabit or use the study area. The physical characteristics of each study will also be summarized. The selection of medium-specific chemicals of concern (COCs) is based on criteria selected to provide an appropriate level of conservatism at this stage of the ecological risk assessment. COCs for the study area will be selected based primarily on comparisons to toxic or potentially hazardous concentrations and/or the potential of a contaminant to bioaccumulate. The exposure assessment includes calculating an environmental effects quotient (EEQ) for eacj COC in each medium of concern (i.e., surface water, sediment). However, biological samples may or may not be analyzed for chemical composition, depending upon the outcome of initial media sampling and ecological field surveys. The potential impacts associated with the ingestion of contaminated biota may therefore be addressed either qualitatively or quantitatively in this risk assessment.

EEQs are based primarily on measured concentrations in various media or estimates as determined by simple algebraic models, such as partitioning coefficients. Average (arithmetic mean) and maximum EEQs will be calculated for medium-specific COCs collected in the study area.

The hazard assessment, also known as toxicity assessment, evaluates concentrations of COCs that are known or likely to result in adverse effects to biota. Crops and livestock will be included in this assessment if hazardous substances are detected within active agricultural areas. Organisms observed at or likely to inhabit or use a study area, including plants, aquatic animals (invertebrates and vertebrates), and terrestrial animals (including birds) will be considered. Toxicity data for these species are sparse; therefore, most toxicity data are based on standard test species that are considered to be representative of similar, related species that might exist in the study area.

Risk characterization is primarily the integration of exposure assessment and hazard assessment; that is, EEQs for medium-specific COCs are compared to toxic or hazardous concentrations (benchmark values) of those COCs. Although several methods have been developed to accomplish the integration of toxicity and exposure evaluations, the "quotient method" is the most frequently used and accepted approach. This method, which provides the basis for this study's risk calculations, divides the EEQ by the selected toxicity benchmark value. The resulting quotient enables the evaluation of relative toxicity between individual COCs; higher quotients are associated with greater potential toxicity.

Chemicals do not exist individually in the natural environment; therefore, cumulative toxicity, or the toxicity associated with chemical mixtures, is an important component of risk characterization. The assessment will address cumulative toxicity by summing all exposure/toxicity quotients associated with each medium-specific COC in each location, resulting in a medium-specific total risk estimate for each location. Cumulative risk will be based on the assumption of chemical additivity, which appears to best represent the toxicity behavior of chemical mixtures.

A secondary component of the ecological risk assessment is the analysis of uncertainty. Uncertainty analysis will also be included as part of the discussions of exposure assessment, hazard assessment, and risk characterization.

Also included under Task 6 is a provision for environmental modelling. This activity will be necessary if site-related hazardous substances are found to have contaminated surface soil. Simple modelling techniques will be used to estimate soil clean-up levels protective of groundwater. A mass-balance model or a similar type of model will be used to calculate soil response clean-up levels based upon groundwater concentrations and aquifer characteristics. Advanced modelling is not anticipated at this time; however, if needed, other modelling could be requested by means of a modification to the scope of work to include appropriate additional data collection activities and modelling efforts.

4.7 TASK 7 - TREATABILITY STUDY/PILOT TESTING

No treatability studies or pilot testing are planned or budgeted at this time for OU-2.

4.8 TASK 8 - REMEDIAL INVESTIGATION REPORT

HNUS will prepare two versions of the OU-2 RI report: a draft for review by EPA, PADER, MDE, and various other government offices and private groups and a final report addressing comments as directed by EPA.

4.8.1 Draft Report Preparation

HNUS will prepare a draft RI report for review by EPA, PADER, MDE, PACE, CURE, and additional interested parties. The report will incorporate data validated during the OU-2 RI investigation and the results of the baseline risk assessment. The report will describe all field activities performed during the OU-2 RI and will present findings and results, as well as results from the initial rounds of sampling conducted as part of the OU-1 ROD requirements. The report format will closely follow EPA guidance.

The RI report will be prepared by consolidating the site investigation documentation and data analysis, the risk assessment, environmental setting, relevant information obtained from file reviews, and review of other data obtained from the local public. The report will include a presentation of the scope of work for the OU-2 RI, the physical characteristics of the site, the nature and extent of contamination, contaminant fate and transport, risk assessment recommendations, and conclusions.

4.8.2 EPA Review and Meeting

Upon completion of the review process for the draft OU-2 RI report, a meeting will be held between HNUS and the EPA staff to

- Discuss and resolve comments
- Reach an agreement or response objectives and a comprehensive list of candidate remedial technologies.
- Establish remedial action objectives for the OU-2 study area.

4.8.3 Revisions and Deliverables

It is anticipated that the draft RI report will be revised once based on the results of the review meeting and written comments received from EPA and others. However, the report will be revised as necessary.

4.9 TASK 9 - REMEDIAL ALTERNATIVES SCREENING

As discussed in Section 3.4 of this work plan, results of information obtained during the RI will be used for the review and evaluation of potential remedial alternatives. The initial RI/FS (OU-1) for the Keystone Sanitation Landfill identified a remedy for the site. However, additional investigation is being conducted to more thoroughly evaluate off-site contamination attributable to the site.

The remedial alternatives screening task involves the first phase of the FS process. The overall objective of this task will be to identify and develop alternatives for possible remedial actions, technology types, and process options in the OU-2 study area. Subsequently, these alternatives will be screened and analyzed so that EPA and other decision makers can compare and select an appropriate remedy or remedies based on information collected during the OU-2 RI. Only those alternatives that pass the initial screening will undergo full evaluation.

The development of a limited number of alternatives will begin before the work plan for the site is finalized. HNUS believes that this effort is necessary in order to identify any data needs that may help screen and evaluate potential alternatives. These data needs will be addressed during the RI field work. Note that the initial development of alternatives will be based on OU-1 RI results and any previous site investigations. The alternatives will be refined (or the number of alternatives will be expanded) as the RI results become available. In addition, data from the OU-2 RI/FS will be provided to the project team conducting RD/RA activities at the Keystone Sanitation Landfill Site.

4.9.1 Development of Remedial Response Objectives and Response Actions

HNUS will develop and establish remedial response objectives that specify the hazardous substances and media of interest, exposure pathways, and remediation goals that permit a range of treatment and containment alternatives. These objectives will be based on contaminant-specific ARARs, other appropriate guidance, and risk-related factors and will consist of medium-specific goals for protecting human health and the environment. The refined conceptual site model will be helpful in developing these objectives. HNUS assumes that several objectives may be appropriate for the site. HNUS also believes that preliminary objectives will be developed in consultation with EPA and other government agencies to help focus FS activities.

Potential contaminant migration pathways and exposure pathways, identified in the risk assessment, will be examined further as a basis for estimating acceptable residual contamination levels. Development ofresponse objectives will also include refining ARARs specific to off-site contamination attributable to the site.

For each medium of interest, HNUS will develop general response actions that define containment, treatment, excavation, or other actions that may be taken to satisfy remedial action objectives. These actions will vary with the medium being addressed and with the local conditions of each area of a particular medium being addressed. HNUS will define the areas of each medium requiring possible remediation (e.g., a discrete unit such as groundwater) and will define the general response actions for each discrete unit

In addition, HNUS will estimate volumes or areas of media to which the general response actions might be applied.

4.9.2 Identifications of Applicable Technologies and Assembly of Alternatives

Using the general response actions developed for OU-2, HNUS will identify the types of technologies (e.g., physical treatment) and process options (e.g., activated carbon adsorption, soil vapor extraction, air stripping) associated with these technologies. These will be screened for technical implementability and a representative process option will be selected for applicable and implementable technologies. The selected process options will then be assembled by HNUS into remedial alternatives for the site.

HNUS will identify and partially develop the following general types of remedial action alternatives as appropriate:

- No action alternative.
- Alternatives that have containment as a principal element.
- Alternatives that utilize treatment as a principal element to reduce contamination.
- Alternatives that utilize treatment to eliminate or minimize the need for long-term management, including monitoring.

For groundwater remedial action alternatives, the element of time will also be considered. More specifically, groundwater alternatives will be assembled and considered that attain ARARs or other health-based criteria in varying lengths of time.

During the identification of remedial alternatives, a number of potentially applicable technology types will be eliminated from further consideration on the basis of technical implementability. HNUS will consider discrete unit contaminant types and concentrations along with other physical and chemical characteristics of these units to screen out technologies that cannot be effectively implemented for OU-2.

4.9.3 Screening of Remedial Technologies and Assembly of Alternatives

HNUS will perform an initial screening of the alternatives to eliminate those that are clearly infeasible or inappropriate. Those alternatives that are shown to be most promising for OU-2 will be analyzed in detail.

The number of alternatives to be carried through screening is assumed to be no more than four and will be coordinated between the HNUS project manager and the EPA RPM.

The results of the initial screening of alternatives, including the development of those remedial alternatives that will be analyzed in detail, will be provided in a draft letter report to EPA, revised in response to EPA comments, and either finalized in a letter report and/or incorporated into the FS report. The letter report will include summary tables displaying the initial screening results.

Information available at the time of initial screening (e.g., OU-1 and OU-2 RI results and the results of RD work for OU-1 will be used by HNUS to identify and distinguish any differences among the alternatives brought forward and to evaluate each alternative with respect to the screening criteria. HNUS assumes that the complete results of the OU-2 RI field work will <u>not</u> be available for the initial screening of alternatives.

HNUS will use three criteria to eliminate from further consideration any technologies and remedial alternatives that are undesirable regarding effectiveness, implementability, and cost. The list of alternatives being considered will be narrowed by eliminating the following types of technologies:

- Technologies/alternatives that are not effective because they do not provide for the overall protection of human health and the environment or do not comply with ARARs.

- Technologies/alternatives that are not implementable or technically applicable.

- Technologies/alternatives that are more costly than other alternatives/technologies but do not provide greater environmental or public health benefits, reliability, or a more permanent solution. Costs alone will not be used to eliminate technologies but may be used to select representative process options.

Alternatives will be evaluated against the short- and long-term aspects of the three broad criteria. For this subtask, the screening comparison will be made between similar alternatives. HNUS assumes that the range of treatment and containment alternatives initially developed will be preserved through the alternative screening process to the extent practicable.

4.10 TASK 10 - REMEDIAL ALTERNATIVES EVALUATION

The more promising alternatives that survive initial screening will be analyzed, developed in detail, and compared to one another. The results of this evaluation will be incorporated into the FS report. The alternatives will be evaluated according to criteria similar to those employed for the remedial action technologies but with an expanded scope and in greater detail.

During the detailed analyses, the alternatives will be evaluated against nine specific evaluation criteria rather than the general criteria used in screening. HNUS will use the following criteria to further develop and evaluate each remedial alternative:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Short-term effectiveness
- Reduction of toxicity, mobility, and volume
- Implementability
- Costs
- State acceptance
- Community acceptance

The last two criteria will not be addressed in the FS but will be deferred to the ROD for OU-2. To the extent possible, remedial alternatives that use permanent solutions and alternative treatment technologies will be considered.

Once each remedial alternative has been more completely developed and evaluated, the alternatives will be compared using the same specific criteria discussed above. The results of the comparative analysis will help determine the relative advantages and disadvantages of remedial alternatives for each discrete unit so that key tradeoffs can be identified.

4.10.1 Overall Protection of Human Health and the Environment

Following the analysis of remedial operations against individual evaluation criteria, the alternatives will be assessed from the standpoint of whether they provide adequate protection of human health and the environment considering the multiple criteria.

4.10.2 Compliance with ARARs

Alternatives will be assessed as to whether they attain legally applicable or relevant and appropriate requirements or other federal and state environmental and public health laws and guidance, including, as appropriate

- Contaminant-specific ARARs (e.g., MCLs).
- Location-specific ARARs (e.g., restrictions on actions at fish and wildlife habitats).
- Action-specific ARARs (e.g., RCRA requirements for incineration and storing and disposing of hazardous wastes).

4.10.3 Long-Term Effectiveness and Permanence

Alternatives will be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the remedy will prove successful. Factors to be considered are

- Type and degree of long-term management required, including monitoring and operation and maintenance.
- Potential for exposure of human and environmental receptors to remaining contamination.
- Long-term reliability of the engineering and institutional controls.
- Potential need for replacement of the remedy.

4.10.4 Reduction of Toxicity, Mobility, or Volume of the Contaminants through Treatment

The degree to which alternatives employ treatment that reduces toxicity, mobility, or volume will be assessed. Factors that are relevant include

- The treatment processes the remedies employ and materials they will treat
- The amount of hazardous materials that will be destroyed or treated
- The degree of expected reduction in toxicity, mobility, or volume
- The degree to which the treatment is irreversible
- The residuals that will remain following treatment

4.10.5 Short-Term Effectiveness

The short-term effectiveness of alternatives will be assessed considering appropriate factors among the following:

- Magnitude of reduction of existing risks.
- Short-term risks that might be posed to the community, workers, or the environment during implementation of an alternative.
- Time until full protection is achieved.

4.10.6 Implementability

The ease or difficulty of implementing the alternatives will be assessed by considering the following types of factors:

- Degree of difficulty associated with constructing the technology.
- Expected operational reliability of the technologies.
- Need to coordinate with and obtain necessary approvals and permits (e.g., NPDES, permits for off-site actions) from other offices and agencies.
- Availability of necessary equipment and specialists.
- Available capacity and location of needed treatment, storage, and disposal services.

4.10.7 Cost

The types of costs that will be assessed include the following:

- Capital costs
- Operation and maintenance (O&M) costs
- Costs of five-year reviews, where required
- Net present value of capital and O&M costs
- Potential future remedial action costs

For each alternative, the cost will be estimated within a range of -30 percent to + 50 percent. The cost analysis will include separate evaluation of capital and O & M costs. Capital costs will consist of short-term installation costs such as engineering/design fees, materials and equipment, construction, and off-site treatment or disposal. O & M costs will consist of long-term costs associated with operating and monitoring the remedial action. Capital and annual O & M costs will be based on the anticipated time necessary for the alternative to achieve clean-up criteria.

A net discount rate (interest rate minus inflation rate) of five percent will be assumed for all present work calculations. Cost estimates will be prepared using data from project field, the current EPA Remedial Action Costing Procedures Manual, EPA technical reports, and quotations from equipment vendors. Equipment replacement costs will be included when the required performance period exceeds equipment design life.

4.10.8 State Acceptance

Based on EPA guidance, HNUS will incorporate state concerns into the remedial alternatives evaluation with regard to the following:

- Components of the alternatives each state supports
- Features of the alternatives for which each state has reservations
- Elements of the alternatives under consideration that each state strongly opposes

Generally, this criterion will be addressed in the ROD.

4.10.9 Community Acceptance

Early readings of community acceptance of and preferences among the alternatives will depend on the degree and type of community involvement in the OU-2 RI/FS process. This assessment will attempt to look at the following:

- Components of the alternatives that the community supports
- Features of the alternatives for which the community has reservations
- Elements of the alternatives that the community strongly opposes

Generally, this criterion will be addressed in the ROD.

4.11 TASK 11 - FEASIBILITY STUDY REPORT

HNUS will prepare two versions of the FS report for EPA: a draft report for review by EPA, MDE, PADER, and task force representatives and a final report incorporating all relevant review comments. HNUS will address all comments and will revise these reports accordingly after comments on technical issues have been resolved.

The draft FS report will incorporate the results of all FS activities (e.g., identifying possible remedial alternatives, screening technology types and process options, developing alternatives, and evaluating and comparing the most promising alternatives for discrete units) for the OU-2 study area. The FS report will build upon site characterization information collected during the OU-1 and OU-2 RI investigations as well as other previous investigations performed for the site. The report format will closely follow EPA guidance.

If necessary, a meeting will be held among HNUS, EPA, MDE, PADER, and task force representatives to

- Discuss and resolve comments
- Reach agreement on response alternatives and the comparative analysis of these alternatives
- Fine tune remedial response alternatives if necessary

It is anticipated that the draft FS report will be revised once, based on the results of the review meeting. However, the final report will be modified as necessary.

4.12 TASK 12 - POST-RI/FS SUPPORT

HNUS will provide support to EPA for any requested assistance in activities that occur after the OU-2 RI and FS reports are finalized. The scope and budget of this task are limited to attendance by key project team members at the public meeting to present final project results.

4.13 TASK 13 - ENFORCEMENT SUPPORT

No activities are planned at this time.

4.14 - TASK 14 - ADMINISTRATIVE CLOSE-OUT

This task covers all efforts related to the work assignment administrative closeout. The task begins after the completion of all technical activities under the work assignment. The following are typical activities:

- Compiling project files.
- Submitting to EPA all requested files (hard copy and two microfiche copies). The requested files will include non-CLP data and CLP and non-CLP data validation packages where available, reports, correspondence, etc.
- Returning any government-owned equipment to the program inventory or the EPA equipment coordinator (if the equipment was purchased with work assignment funds).
- Verifying that all appropriate site charges are being processed for inclusion in the final invoice and then submitting the final invoice.

TABLE 4-7
TASK NUMBERING SCHEME
KEYSTONE SANITATION LANDFILL SITE

RI/FS TASK		EPA STATEMENT OF WORK	
0101	Site Visit	1A	Site background and initial site visit.
		Interim Task 3 (SOW Revision No. 2)	
0102	Collect and Evaluate Data	1A	Site background and initial site visit.
		Interim Task (SOW Revision No. 2)	
0103	Brainstorming Activities	1B	Project Planning
0104	Draft Work Plan	1B1	Preliminary remedial action objective and alternatives.
		$1B_2$	Treatability studies.
		$1B_3$	Identification of ARARs.
		$1C_1$	RI/FS work plan
		Interim Task 4 (SOW Revision No. 2)	
0105	Draft Sampling and Analysis Plan (SAP) and Health and Safety Plan (HASP)	1C2	SAP
		$1C_3$	HASP
		Interim Task 2 (SOW Revision No. 2)	
0106	Program/Project Management	1B	Project planning
0107	Final Work Plan	$1C_1$	RI/FS work plan
0108	Final Sampling Analysis Plan (SAP)/Health and Safety Plan (HASP)	$1C_2$	SAP
		$1C_3$	HASP
0210	Information Repositories	Remove documents from two to of four information repositories; prepare index of documents in remaining repositories and update as necessary. (SOW Revision No. 1)	
0211	Task Force/Public Meetings	Attend monthly task force meetings; prepare and distribute pre-and post-meeting information. (SOW Revision No. 1)	
0212	Community Relations Implementation	Prepare two fact sheets (SOW Revision No. 1)	
0315	Mobilization/Demobilization	Interim Task 2 (SOW Revision No. 2)	
		$1A_1$	Field Support Activities

TABLE 4-7
TASK NUMBERING SCHEME
KEYSTONE SANITATION LANDFILL SITE
PAGE 2 OF 3

RI/FS TASK		EPA STATEMENT OF WORK	
0316	Monitoring Well Sampling	$1A_2$(b)	Describe the nature and extent of two.
		Interim Task 2 (SOW Revision No. 2) (Contamination)	
0317	Procure Subcontractors	Interim Task 2 (sow Revision No. 2)	
		$3A_1$	Field Activities Support
0318	Geological/Hydrologic Investigation	Interim Task 2 (SOW Revision No. 2)	
0319	Investigation-Derived Waste (IDW) Management	Interim Task 2 (SOW Revision No. 2)	
0320	Soil Gas Survey	$3A_2$(a)	Define sources of contamination.
0321	Ecological Assessment	3A(2)	Describe site biological characteristics.
		3A(2)b	Describe nature and extent of contamination.
0322	Site Survey	3A(2)	Define site physical and biological characteristics
0323	Surface Water/Sediment Sampling	3A(2)	Define Site 11 physical and biological characteristics.
		3A(2)	Describe nature and extent of contamination.
0324	Residential Well Sampling	3A(2)	Describe site physical and biological characteristics.
		3A(2)b	Define nature and extent of contamination.
0325	Soil Sampling	3A(2)	Describe site physical and biological characteristics.
		3A(2)(a)	Define sources of contamination.
0430	Sample Management	3B(2)	Data management procedures
		Interim Task 2 (SOW Revision No. 2)	
0431	Data Validation	3B(2)	Data Management Procedures
0532	Data Evaluation	3B(2)C	Preliminary Site Characterization Summary
0533	Data Reduction and Tabulation	Interim Task 2 (SOW Revision No. 2)	
0534	Environmental Modeling	3B(1)	Evaluate site characteristics.
0535	Technical Directive Memorandum		
0636	Environmental Risk Assessment	3C(2)	Remedial Investigation Report

TABLE 4-7
TASK NUMBERING SCHEME
KEYSTONE SANITATION LANDFILL SITE
PAGE 3 OF 3

RI/FS TASK		EPA STATEMENT OF WORK	
0637	Ecological Risk Assessment	3C(2)	Remedial Investigation Report
0638	Environmental Modeling	3B(1)	Evaluate site Characteristics.
		3C(2)	Remedial Investigation Report
0841	Prepare Draft OU-2 RI Report	3C(2)	Remedial Investigation Report
0842	Prepare Final OU-2 RI Report	3C(2)	Rededial Investigation Report
0944	Development of Remedial Response Objectives and Response Actions	5(A)1	Define and document remedial action objectives.
0945	Identification of Applicable Technologies and Assembly of Alternatives	5(A)1	Define and document remedial action objectives.
		5(A)2	Develop general response actions.
		5(A)3	Identify areas or volume of media.
0946	Screening of remedial technologies and assembly of alternatives.	5(A)4	Screen and document remedial technologies.
		5(A)5	Assemble and document alternatives.
		5(A)6	Define alternatives.
		5(A)7	Conduct and document screening evaluation of each alternative.
1047	Public health evaluation of remedial alternatives.	6A(1)	Apply nine criteria and document analysis.
1048	Technical evaluation of remedial alternatives.	6A(2)	Compare alternatives against each other and document the comparison of alternatives.
1049	Cost evaluation of remedial alternatives.	6A(1)	Apply nine criteria and document analysis.
		6A(2)	Compare alternatives against each other document the comparison of alternatives.
1150	Prepare draft OU-2 FS report.	6B	Feasibility Study Report
1151	Prepare final OU-2 FS report.		
1252	Record of Decision Support.		
1253	Responsiveness Summary.		
1300	Enforcement Support.		
1754	Work Assignment Close-out	6B	Feasibility Study Report

SECTION 5.0

5.0 PROJECT MANAGEMENT APPROACH

5.1 ORGANIZATION AND APPROACH

The proposed project organization for the OU-2 RI/FS is shown in Figure 5.1. The HNUS ARCS III program manager, Leonard C. Johnson, is responsible for the quality of all ARCS work performed in Region III. William Wentworth will serve as the HNUS project manager. The project manager has primary responsibility for implementing and executing the RI/FS. Supporting the project manager are the site manager, site geologist, laboratory services coordinator risk assessment specialist, and the feasibility study coordinator. The site manager is responsible for the on-site management of activities for the duration of the site investigation. For this project, HNUS intends to utilize the ARCS III team subcontractor, Gannett Fleming (GF), for field support. GF will supply field geologists and field technicians. The subcontractor personnel will report to the HNUS site manager in the field. The HNUS project manager will be responsible for overseeing all work performed by Gannett Fleming.

The OU-2 RI/FS tasks included in this work plan, in addition to the schedule and budget, comprise the baseline plans. These plans form an integrated management information system against which work assignment progress can be measured. The baseline plans are a precise description of who the work assignment will be executed in terms of scope, schedule, and budget. The project schedule is presented in Section 5.3.

5.2 QUALITY ASSURANCE AND DATA MANAGEMENT

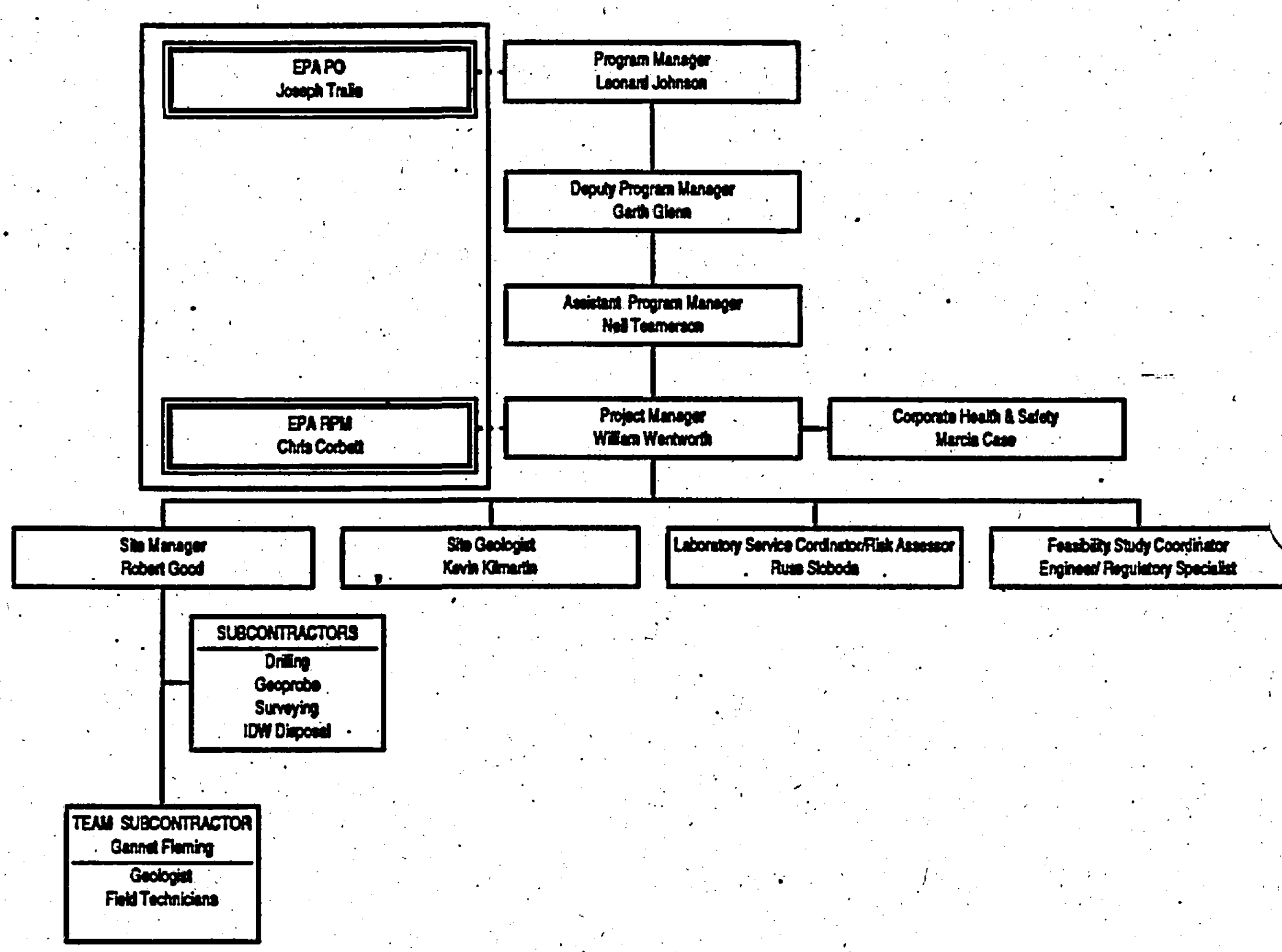
The site-specific quality assurance requirements will be in accordance with the QAPP for the ARCS III program, as previously approved by EPA. The QAPP will be part of the SAP for the site. The ARCS QAPjP provides general guidance on the following subjects.

- Project organization and responsibility.
- QA objectives for measurement of data in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC).

Data management aspects of the program pertain to controlling and filing documents. HNUS has developed a program filing system that conforms to the requirements of EPA and the ARCS III program to ensure that the integrity of the documents is safeguarded. This guideline will be implemented to control and file all documents associated with the OU-2 RI/FS. The system includes document receipt control procedures, a file review and inspection system, and security measures to be followed.

DRAFT

Project Organization Chart
Keystone Landfill
Adams County, Pennsylvania



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5.3 PROJECT SCHEDULE

Figure 5.2 depicts the proposed schedule of tasks and activities for the Keystone Landfill Site RI/FS. The schedule for the field investigation assumes that no site restrictions will be encountered and is dependent upon approval of the work plan and other project planning documents as indicated.

5.4 PROJECT COSTS

An Optional Form 60 (OF-60) with detailed cost backup will be submitted under separate cover to EPA.

FIGURE 5-2
KEYSTONE LANDFILL
OU-2 RI/FS INVESTIGATION
SCHEDULE AND MILESTONES

TASK	DATE*	
	START	FINISH
Final Work Plan	August 11, 1994	September 2, 1994
Final SAP and HASP	August 11, 1994	September 2, 1994
Field Investigation		
• Monitoring Wells	**August 22, 1994	May 26, 1995
• SW/SD	September 6, 1994	March 3, 1995
• Residential Wells	September 26, 1994	December 15, 1994
• Soil Gas	October 3, 1994	October 14, 1994
• Soil	October 24, 1994	October 28, 1994
• Hydrological Investigation	November 14, 1994	December 22, 1994
Laboratory Analysis	October 3, 1994	June 29, 1995
Data Evaluation	September 22, 1995	August 31, 1995
Draft RI Report and Risk Assessment	July 27, 1995	October 1995
Draft FS Report	September 7, 1995	December 1995
Final RI Report and Risk Assessment	February 1996	March 1996
Final FS Report	February 1996	March 1996
ROD Support	April 1996	June 1996

* The proposed schedule provided is contingent upon work plan approval by September 1, 1994.

** Funding for the initial round of monitoring well sampling was approved in April 1994.

SECTION 6.0

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